PLANS FOR CONCRETE FARM BUILDINGS

Plans for Concrete Farm Buildings

Planning Farm Buildings

THE planning of farm structures, whether for a single unit or complete farmstead, is a challenge to the designer and builder to construct adequate and efficient buildings at costs that will assure the farmer profitable return on his investment.

Shrewd analysis of building materials commonly used on farms today will point squarely to some form of concrete construction. First cost of concrete is reasonable. Rotproof, termiteproof, and weatherproof concrete assures low maintenance and repair costs. Firesafety, attractiveness, and cleanliness are other factors which have made concrete buildings popular on farms as well as in cities.

The use of plans which are approved by farm building specialists can do much towards helping farmers obtain the kind of buildings needed and providing for the many small but important features often overlooked.

The drawings in this publication are typical designs and should not be used as working drawings. They are intended to be helpful in the preparation of complete plans which should be adapted to local conditions and should conform with legal requirements. Working drawings should be prepared and approved by a qualified engineer or architect.

Valuable suggestions may often be obtained from county agricultural agents or state colleges.

The general plan of the book is to present essentials of quality concrete and sound building construction on the farm. An outline of subjects covered is provided in the index on page 56.

Portland Cement Association

The activities of the Portland Cement Association, a national organization, are limited to scientific research, the development of new or improved products and methods, technical service, promotion and educational effort (including safety work), and are primarily designed to improve and extend the uses of portland cement and concrete.

The manifold program of the Association and its varied services to cement users are made possible by the financial support of over 60 member companies in the United States and Canada, engaged in the manufacture and sale of a very large proportion of all portland cement used in these two countries. A current list of member companies will be furnished on request.

How to Make Quality Concrete

TO be assured of maximum service and satisfaction from concrete improvements, it is important that the concrete be of good quality. And, it is just as easy to make concrete of good quality which gives excellent service as to make concrete of poor quality which may give disappointing results. A few simple rules carefully followed result in good concrete.

Concrete is a mass of sand and gravel, the particles of which are coated and held together by a cement paste. The cement paste is made as portland cement and water are stirred together in mixing the concrete. If the cement paste is rich and strong the concrete will be strong. On the other hand, if the paste is weak and watery the concrete will be poor. Factors affecting the strength of the cement paste and the durability of the concrete are explained below.

Water

Mixing water for concrete should be clean enough to drink.

Portland Cement

Portland cement should be kept in a dry place. Any cement containing lumps so hard that they do not readily pulverize when struck lightly with a shovel, should not be used.

Sand and Gravel*

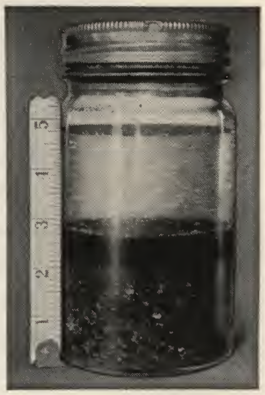
Sand should be clean, hard and well graded, that is with particles of many sizes from very fine up to those which will pass through a No. 4 screen (4 openings per lin.in.). **Gravel** should be clean, hard and range in size from 1/4 in. up to about 1 1/2 in. for most work. Silt, clay and loam are objectionable in sand and gravel to be used in making concrete as they coat the particles and prevent the cement paste from bonding to them, resulting in weak, porous concrete. *A good rule to follow is to haul sand and gravel from pits which are known to make good concrete.*

*Crushed stone or crushed slag may be used in place of gravel.

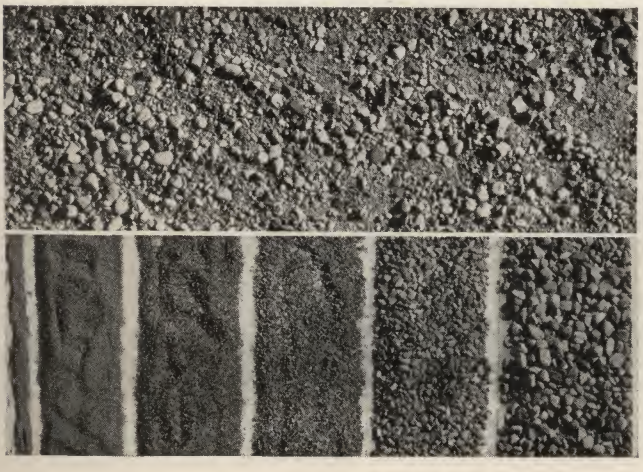
Silt Test

Sand and bank-run gravel may be tested to determine whether they contain injurious amounts of finely divided clay or silt as follows:

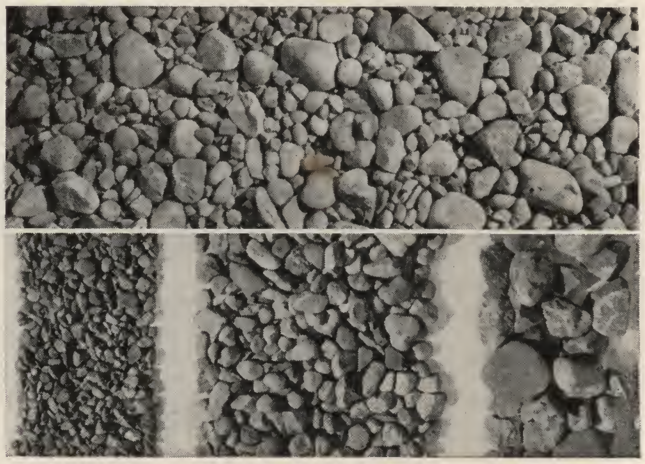
1. Place 2 in. of representative sample of sand or gravel in a pint fruit jar.
2. Add water until the jar is almost full, fasten the cover, shake vigorously, then set the jar aside until the water clears.
3. Measure the layer of silt covering the sand or gravel. If this layer is more than 1/8 in. thick the material is not clean enough for concrete unless washed.



The silt test quickly reveals whether or not sand or gravel is clean enough to make good concrete. This sand contains more silt than is allowable and should be washed before using in concrete.



Good concrete sand is shown at top. Sizes vary from very fine up to small pebbles which will just pass through a 1/4-in. sieve. The variety of sizes needed in a good concrete sand is illustrated by the six sizes below which were screened out of the natural mixture of sand above.



Good concrete gravel is shown at top. Note the variety of sizes, the smaller stones filling in spaces between larger ones. The three samples below were obtained by screening the natural mixture of gravel above. Smallest sizes are 1/4 to 3/8 in.; next are 3/8 to 3/4 in.; largest are 3/4 to 1 1/2 in.

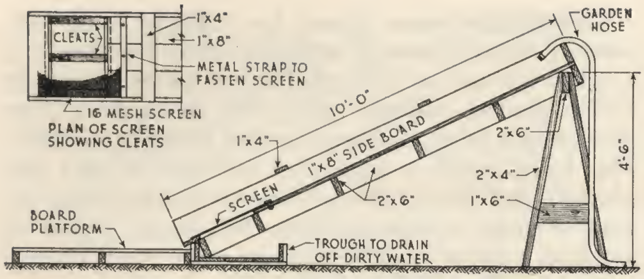


FIG. 1. Sloping table for washing bank-run gravel.

Sand and bank-run gravel containing too much silt or clay may be washed to make them clean for use in concrete. A satisfactory washing table is illustrated in Fig. 1. It consists of a wide, shallow, sloping trough. The material is shoveled onto the high end where it is drenched with water by means of a hose or pail, washing out the objectionable silt or clay. The material should be retested after washing to make sure that it is clean.

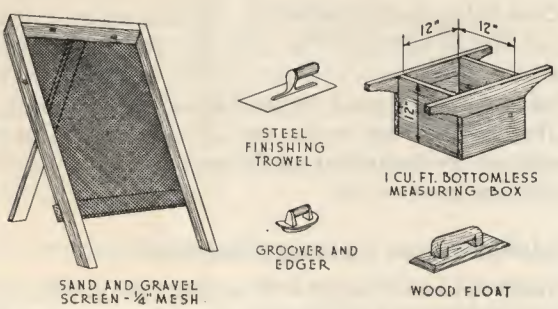


FIG. 2. Some of the tools and equipment needed for farm concrete jobs. A bottomless box holding 1 or 2 cu.ft. makes a convenient measure for proportioning sand and gravel.

Vegetable Matter Test

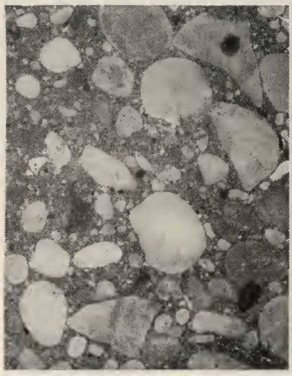
Sand and gravel sometimes contain harmful amounts of decomposing vegetable matter. Concrete made with such sand or gravel may not harden or the resulting concrete may be of low strength. A test to see whether sand or gravel is fit for use in concrete may be made as follows:

1. Dissolve a heaping teaspoonful of household lye into ½ pint of water contained in a 1-pint fruit jar. (Fruit jar should be of colorless glass.)
2. Pour ½ pint of a representative sample of sand or gravel into the jar containing the lye water.
3. Cover the jar tightly and shake vigorously for 1 or 2 minutes.
4. Set the jar aside for 24 hours, then inspect in good light.
5. If the water is clear or colored not darker than apple cider vinegar, the material is suitable for use in concrete. However, if the color of the water is darker than this, the material should not be used for concrete before it is washed to remove the objectionable vegetable matter.

Mixing and Placing Concrete

Strong, watertight, durable concrete can readily be made by following carefully the suggestions given here. Measure all materials—water, cement, sand and gravel. It is especially important that only a limited, measured amount of water be used in the concrete mix. Where too much water is added the cement paste which holds the mass of sand and gravel together will be diluted and weak. Weak cement paste means weak, porous concrete which is sure to be unsatisfactory.

Concrete materials may be measured as follows: Water is conveniently measured in a pail marked off in gallons and half gallons. Sand and gravel may be measured in a 1-cu.ft. bottomless box (*see Fig. 2*). Portland cement is usually obtained in sacks, each sack holding 1 cu.ft. Cement in quantities less than 1 sack may be measured as portions of a cubic foot in the bottomless 1-cu.ft. box or in pails.



A cross section of economical, durable concrete looks like this. It was obtained through use of proper amount of gravel properly graded and thoroughly mixed.

A good concrete mix for most farm jobs looks like this. Note that mix is fairly stiff, yet because of proper proportioning there is sufficient cement-sand mortar to make smooth, dense surfaces. Few farm jobs should have a wetter mix than this.

A small machine mixer is most convenient for farm concrete jobs of any size. Note separate piles of sand and gravel. It is particularly important to use the proper quantity of water in the concrete mix as discussed above.

Table I—Suggested Concrete Mixes*

Use of concrete	U. S. gal. of water per sack cement with average moist sand	Sand and gravel per sack cement		Largest size of gravel
		Sand, cu.ft.	Gravel, cu.ft.	
Most farm construction such as floors, steps, basement walls, walks, yard pavements, silos, grain bins, water tanks, etc.	5	2¼	3	1½ in.
Concrete in thick sections and not subject to freezing. Thick footings, thick foundations, retaining walls, engine bases.	5½	2¾	4	1½ in.
Thin reinforced concrete such as milk cooling tanks, fence posts, thin floors, most uses where concrete is 2 in. to 4 in. thick.	5	2¼	2½	¾ in.
Very thin concrete such as top course of 2-course floors and pavements, concrete lawn furniture, most uses where concrete is 1 in. to 2 in. thick	4	1¾	2¼	⅜ in.

*These are trial mixes for average conditions. *It is particularly important to use not more water per sack of cement than shown in the table.* If sand is very wet decrease amount of water used 1 gal. per sack of cement. If sand is dust dry increase amount of water ½ gal. per sack of cement. Change proportions of sand and gravel slightly if necessary to get a workable mix.

Suggested concrete mixes are given in Table I. The 1:2¼:3 mix (1 sack portland cement to 2¼ cu.ft. sand to 3 cu.ft. gravel) is used for most kinds of farm concrete work. These are trial mixes for average conditions. Change proportions of sand and gravel slightly if necessary to get workable mixes. By a workable mix is meant one which is smooth and plastic and will place and finish well. It should not be so thin that it runs or so stiff that it crumbles. It should be rather sticky when worked with a shovel or trowel. For most work a workable mix is one which is "mushy" but not "soupy".

For machine-mixing allow 1 to 2 minutes' mixing after all materials are in the mixer. Freshly mixed concrete should be placed in the forms immediately, then tamped and spaded or vibrated to assure smooth surfaces and dense concrete. A 1x4 board sharpened to a chisel edge or a garden hoe with the blade straightened out makes a satisfactory concrete spade. If an appreciable amount of water comes to the top while spading and tamping, it is a warning that the mix is too wet. To remedy a wet mix make sure that no more water is added per sack of cement than suggested in Table 1. If the right amount of water is being used, a wet mix may be corrected by increasing slightly the amounts of sand and gravel in following batches.

Construction joints caused by stopping work temporarily demand special attention. Best practice is to roughen the surface with a stiff broom before it hardens. Before placing concrete again, wet the surface, then cover with a layer of cement mortar about ½ in. thick. This helps insure a tight joint between old and new concrete and largely prevents stone pockets along the joint. Cement mortar is made by mixing 1 part of portland cement to 2½ parts of sand with enough water to make a "mushy" workable mix.

Hand-mixing is done as follows: Place the measured amount of sand on a watertight mixing platform. Spread the cement evenly over the sand and turn the two materials with a shovel until a uniform color shows that the sand and cement are thoroughly mixed together. Spread this mixture out evenly and add the measured amount of gravel. Mix thoroughly again, then form a hollow in the material and slowly add the measured quantity of water. Mixing should continue until every particle has been completely covered with cement paste.

Concreting in Cold Weather. Mixing water, sand and gravel should be heated for making concrete in freezing weather and the new concrete should be protected from freezing for at least 3 days. Materials containing ice or frost should never be used in concrete. Concrete should not be deposited on frozen ground nor in forms containing frost or ice.

Finishing and Curing Concrete

Newly placed concrete is leveled off in the forms with a strikeboard or wood float, then the wood float is used to make an even surface. Further finishing is delayed until the concrete hardens enough to become quite stiff. If a gritty, nonskid floor is desired, a wood float is used to produce the final finish. If a smooth, dense surface is required, a steel trowel is employed in finishing.

Stony spots found when forms are removed may be patched by working a stiff cement mortar into them with a wood float. The mortar should be 1 part portland cement to 2½ parts sand.

Concrete needs moisture to harden properly, that is, to cure. New concrete should, therefore, be protected from drying out for at least 5 days. Floors and other horizontal surfaces should be covered with burlap, earth, straw, etc., and the material kept wet for the required time. Walls should be covered with canvas or burlap, etc., and this covering kept wet. Some protection may be secured by leaving forms in place.

Reinforced Concrete

Steel rods called reinforcing bars, and wire mesh reinforcement are often used in concrete to strengthen it against pulling or bending forces. Reinforcement must be free from rust scale and other coatings. Scrap iron and rusty fence wire should never be used as reinforcement. Standard reinforcing bars or mesh should be used, placed exactly in the position called for in the plans. See Fig. 3 for important steps in placing reinforcement. At laps, bar ends should extend

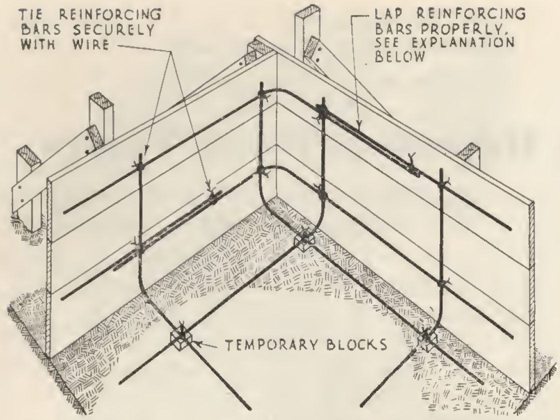


FIG. 3. Reinforcing bars should be placed as shown here. At laps bar ends should extend past each other as explained below. Reinforcement is supported on blocks to assure proper depth of concrete under the bars, then blocks are removed as concreting progresses. Always bend reinforcement around corners as shown.

past each other as follows:

¼-in. round bars—12 in.
⅜-in. round bars—1 ft. 6 in.
½-in. round bars—2 ft.
⅝-in. round bars—2 ft. 6 in.
¾-in. round bars—3 ft.

At laps and intersections, bars should be tied together with No. 15 or 16 gage wire. Important work should be designed and supervised by a competent engineer or contractor.

Watertight Concrete

Concrete mixes described in Table I, except the 1:2¾:4 mix, will make watertight concrete if all the suggested steps in construction are faithfully performed. It is particularly important that no more water be used in the mix than is specified in the table and that concrete be kept moist for a hardening or curing period of at least 7 days.

How to Estimate Quantities of Material Needed

Table II shows the amount of materials required per cubic yard (27 cu.ft.) of concrete. Find the number of cubic yards of concrete needed to fill the forms and multiply this by the factors given in Table II. It is best practice to increase material quantities about 5 to 10 per cent to allow for waste and variables in the work.

Amount of materials required for concrete floors, walls or other plain flat slabs of concrete may be determined from Table III which shows approximate amounts of materials needed per 100 sq.ft. of the most commonly used concrete mix, 1:2¼:3. For example, concrete materials required for a poultry house floor 20x30 ft. and 4 in. thick may be computed in this way: From Table III—100 sq.ft. of 4-in. floor requires 7¾ sacks of cement, ¾ cu.yd. of sand, and 1 cu.yd. of gravel.† For a floor of 600 sq.ft., as in our problem, find approximate amounts of material needed by multiplying these quantities by 6:

7¾ × 6 = 46½ sacks of cement
¾ × 6 = 4½ cu.yd. sand
1 × 6 = 6 cu.yd. of gravel

Table II—Approximate Amounts of Materials Required Per Cubic Yard of Concrete*

Use of concrete	Sacks of cement	Sand, cu.yd.	Gravel, cu.yd.	Largest size of gravel
Most farm construction such as floors, steps, walks, tanks, silos, etc. **1:2¼:3 mix**	6¼	⅔	¾	1½ in.
Concrete in thick sections and not subject to freezing. Thick footings and foundations, etc. **1:2¾:4 mix**	5	⅔	¾	1½ in.
Thin reinforced concrete such as milk cooling tanks, fence posts, slabs 2 in. to 4 in. thick. **1:2¼:2½ mix**	6½	⅔	¾	¾ in.
Very thin concrete as for lawn furniture, top course of 2-course floors, concrete 1 in. to 2 in. thick. **1:1¾:2¼ mix**	8	⅔	¾	⅜ in.

***Amounts of sand and gravel required should be increased about 5 to 10 per cent to allow for waste and variables.**

Table III—Approximate Amounts of Materials Required Per 100 Sq.Ft. of 1:2¼:3 Mix Concrete*

Thickness of concrete, in.	Concrete, cu.yd.	Sacks of cement	Sand, cu.yd.	Gravel, cu.yd.
4	1⅓	7¾	¾	1
6	2	11⅔	1	1⅓
8	2½	15½	1⅓	1¾
10	3	19⅓	1¾	2¼
12	3¾	23	2	2⅔

***Amounts of sand and gravel required should be increased about 5 to 10 per cent to allow for waste and variables.**

Table IV—Approximate Amounts of Materials Required Per 100 Sq.Ft. of Portland Cement Mortar or Concrete

Thickness of mortar or concrete, in.	Amount of mortar or concrete, cu.yd.	Mix proportions				
		1:3		1:1¾:2¼		
		Sacks of cement	Sand cu.ft.	Sacks of cement	Sand, cu.ft.	Gravel (⅜ in.), cu.ft.
⅜	⅛	1	3	...	..	..
¾	¼	2	6	...	..	..
1	⅓	2¾	8	2⅔	6	7
1½	½	...	...	4	8	10
3	1	...	...	8	16	19

Table IV can be used to estimate approximate materials needed for various thicknesses of portland cement mortar or plaster and for concrete ⅜ to 3 in. thick.

†If concrete aggregates are sold in your locality by weight you may assume, for estimating purposes, that a ton contains approximately 22 cu.ft. of sand or crushed stone; or about 20 cu.ft. of gravel. For information on local aggregates consult your building material dealer.

Concrete Footings, Foundations, Basement Walls, Floors

Forms for concrete footings are often made of 2x8 or 2x10 planks as shown here. The stiff concrete mix requires some spading to assure dense, solid concrete.

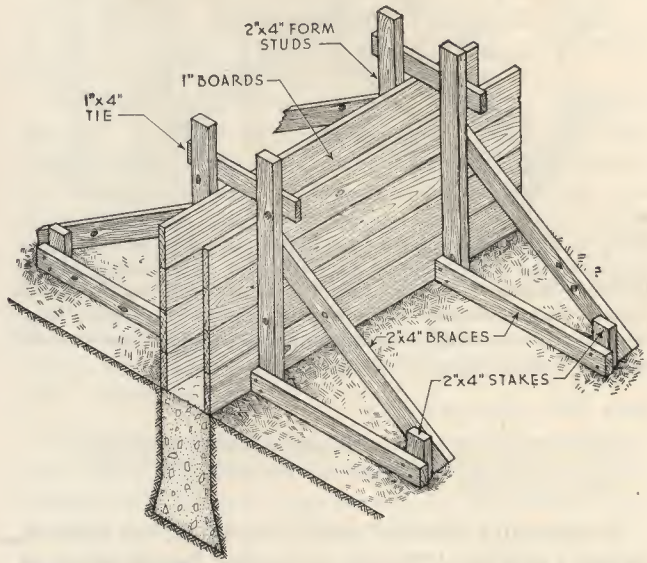


FIG. 5. Foundation walls above grade may be formed in this manner where earth walls of the trench stand straight and true, and where a wide footing is not required. Most foundations should have a footing, however, in which case the foundation is formed as shown in Fig. 6.

Footings and Foundations

Adequate, well-built concrete footings and foundation walls prolong the life of a building and reduce to a minimum danger of cracked walls and other failures which cause expensive and annoying repairs. Concrete foundations also provide permanent protection against rats, termites and rot.

Size of footings required under the foundation wall depends upon the size and weight of the building supported and also upon the type of soil encountered at the footing level. Some soils will carry much heavier loads than others. For example, soft clay soil should not be loaded heavier than 1 ton per sq.ft., while firm blue clay will safely carry twice this load. In all cases the footing slab should be placed on firm soil below frost penetration. With average soil conditions (firm clay or a mixture of sand and gravel and clay) it is customary to make the footing width equal to twice the thickness of the foundation wall above. Depth of the footing is usually made equal to the thickness of foundation wall.

Small buildings such as poultry or hog houses usually have a footing 16 in. wide and 8 in. deep for average soil conditions. Larger and heavier buildings such as barns, large granaries, corn cribs, etc., should have foot-

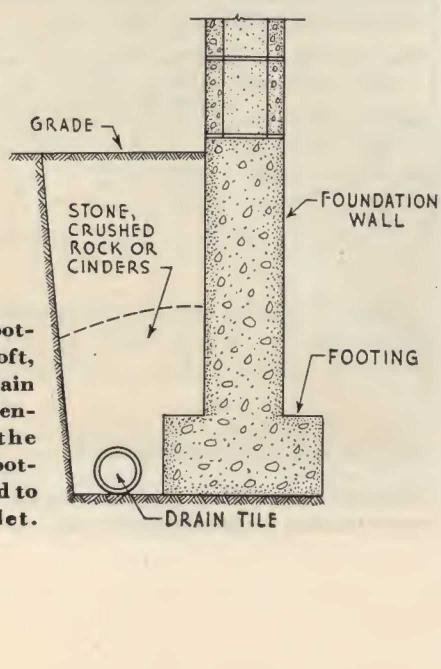


FIG. 4. Where footings are built in soft, wet soils, a tile drain should be placed entirely around the building at the footing and connected to a suitable outlet.

Simple forms of this kind serve for concrete footings which are to support posts or piers.

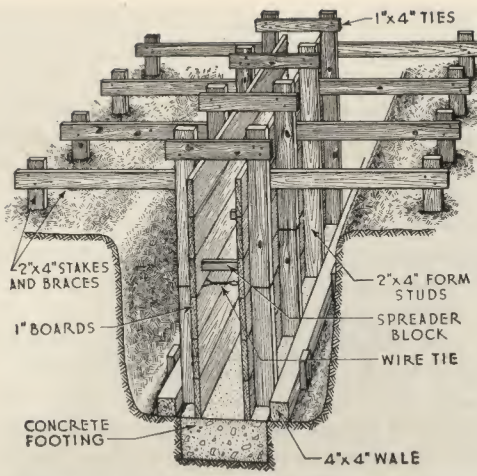


FIG. 6. Suggested method of forming for foundations which are supported on footings.

ings 24 to 30 in. wide and about 12 in. deep. Where very soft clay, muck or quicksand is encountered, width of footing should be doubled and best practice is to provide tile drainage around the footing.

Foundation walls are built of either cast-in-place concrete or concrete masonry units. The thickness of the foundation wall is usually the same as the concrete masonry wall it supports and is seldom less than 8 in. In building two or more stories in height as in the case of large barns, the foundation wall is usually made 10 to 12 in. thick.

Footing slabs under posts and columns demand special attention. Posts and columns in many farm buildings support heavy loads and it is important that the footing area be great enough to prevent settlement of the post and consequent sagging of the structure above. Post footings in small buildings and for light loads may be built 1½ to 2 ft. square and 9 to 12 in. thick; for heavy loads such as those found in large or heavily loaded barns, grain storages, etc., the footing should be 2½ to 3 ft. square and 12 to 15 in. thick.

Forms for high concrete walls must be adequately braced to assure straight, plumb walls.

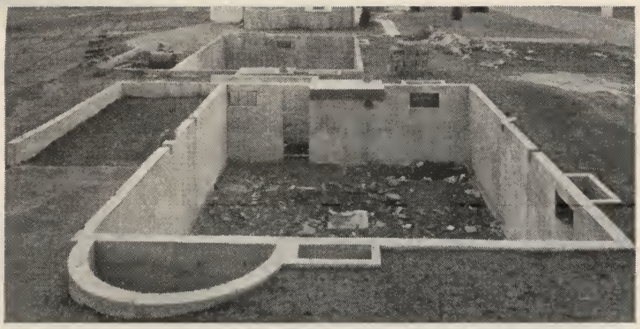
Forms for foundation walls above grade are shown in Figs. 5 and 6. Forms are usually of 1-in. boards backed up with 2x4 or 4x4 studs, spaced about 16 in. apart. Opposite sections of forms are tied together with wires looped around each opposite pair of form studs. Ties are ordinarily spaced about 24 in. apart along the stud and may consist of single strands of No. 9 or No. 10 gage soft iron wire or doubled strands of No. 12 wire. Small spreader or spacer blocks, cut in lengths equal to the thickness of the wall desired, are placed in the forms and the wire ties are then twisted to hold the spreaders tightly in place. These spreader blocks must, of course, be removed as filling of the forms with concrete progresses. Form faces may be painted with engine oil to prevent concrete from sticking.

Correct concrete mixes for footings and foundations are given in Table I, page 4. Best results are obtained when a rather stiff mix is used. Concrete should be placed in the forms in layers not deeper than 6 in. and if possible the complete wall should be cast in one continuous operation. If it is necessary to interrupt the work, however, construction joints should be given special treatment as described on page 4.

Watertight basement walls are built without difficulty if certain precautions are taken. Quality concrete and first-class workmanship are perhaps the most important factors. A worthwhile precaution to insure a dry wall is to place a line of drain tile entirely around the building at the footing level as shown in Fig. 4. The tile line should slope at least 1 in. in 25 ft. and should lead to an adequate outlet. Coarse material such as crushed rock, cinders or stone should be placed over the tile to a depth of at least 18 in. to permit quick drainage.

In building dry basement walls of concrete masonry, it is good practice to apply two coats of portland cement plaster on the exterior surface. The plaster mix should consist of 1 sack of portland cement to 2½ cu.ft. of

Thorough spading of concrete along form faces helps assure smooth, watertight concrete walls.



Quality concrete and well-built forms help produce smooth, attractive basement walls of cast-in place concrete.

damp mortar sand. Each coat should be about ¼ in. thick. The first coat is scratched or roughened before it hardens to provide good bond for the second coat. The second coat may be applied on the day following the first coat. Keep plaster moist for several days by frequent sprinkling.

Concrete Floors

Concrete floors are widely accepted as the most satisfactory type of floors for most farm buildings because they last indefinitely, are easy to clean and convenient to work on.

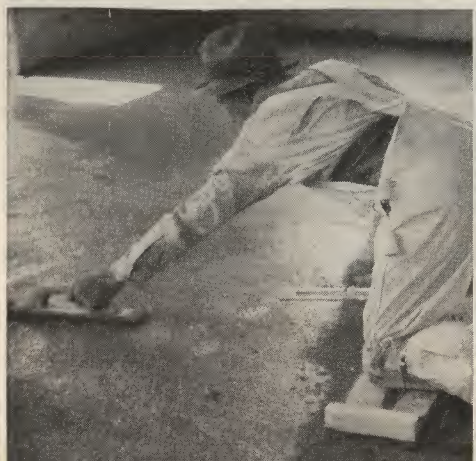
Before concrete is placed, the floor area should be cleared of all debris, then carefully leveled or given the desired slope. Many floors are sloped about ¼ in. in 1 ft. to drain readily. Filling placed in low spots should be tamped thoroughly to provide a firm base for the concrete slab. Floors for most farm buildings are built about 4 in. thick, 2x4 side forms commonly being used as a guide for the thickness. Floors which will receive hard or heavy usage should be built about 6 in. thick.

As shown in Table I, page 4, a 1:2¼:3 concrete mix is suggested for most farm building floors. The concrete mix should be rather stiff so that some tamping is required in placing. The full thickness of concrete should be placed in one operation. Freshly placed concrete is leveled flush with the top of the forms by means of a strikeboard which is worked back and forth across the surface with a slow, saw-like motion. A straight 2x4 about 10 ft. long makes a convenient strikeboard for large floors, correspondingly shorter lengths being used on smaller work. The new concrete is allowed to harden until it becomes quite stiff, then it is finished with a wood float and a steel finishing trowel. The wood float is used to make an even, uniform surface and it may also be used for final finishing if a gritty, nonskid surface is desired. Where a very smooth, dense floor surface is desired, final finishing should be with a steel finishing trowel after the water sheen on the surface has disappeared and the concrete has become quite stiff. The finishing trowel should be used sparingly, however, because over-troweling will result in surfaces which dust and craze readily. The new concrete floor should be cured properly, as explained on page 4.

Warm, Dry Concrete Floors. In some cases a special method of construction is employed to assure dry concrete floors. Thoroughly dry floors are a necessity in grain storage buildings and in some other storage structures. Poultry house, hog house and certain other floors may in some cases require special attention to moisture-proofing. A first requirement for a dry floor is that it be placed on a site that is well-drained. If the site does not have good natural drainage, the concrete floor should be placed on a fill. Construction is then as follows:

On a well-tamped fill of gravel, cinders or crushed rock having a thickness of 6 to 12 in. above grade, place a 1½-in. base course of concrete. This thin concrete layer is then leveled and left to harden. After it has hardened, place asphalt roll roofing or tough waterproof building paper on the concrete base course, lapping and carefully cementing joints with mastic. Complete the floor by placing a top layer of concrete about 3 in. thick. New concrete floors should be allowed to age and dry out thoroughly before materials which might be injured by dampness are placed on them.

FINISHING CONCRETE FLOORS



After concrete becomes quite stiff but is still workable, the wood float is used to compact the surface and smooth out uneven spots left by strikeboard. No further finishing is required on barn floors and other areas where even, yet gritty, nonslip surface is desired.

After concrete has hardened enough to become quite stiff the steel finishing trowel is employed to make a smooth, dense surface. The finishing trowel should be used sparingly since over-troweling produces surfaces which, after hardening, tend to check and dust.

A broomed finish is desirable where more than normal traction is wanted to make a nonslip floor, cattle walk or pavement. Concrete is brushed with a stiff broom after it has been wood floated and steel troweled.

Attractive farm buildings of concrete block or concrete building tile are secured when a few simple rules of good concrete masonry construction are followed.

Concrete Masonry Construction

Concrete masonry units, that is, concrete block, concrete building tile and concrete brick, are widely used in constructing all types of farm buildings. The growing popularity of concrete masonry construction for farm structures is due to its economy, durability and firesafety—these advantages mean low maintenance costs and long life. Masonry units are readily obtainable from local concrete products manufacturers.

Sizes and Shapes

Concrete masonry units are made in several convenient shapes and sizes. The nominal 8x8x16-in. unit referred to as a concrete block is the size most widely used. It is laid in courses 8 in. high and makes a wall 8 in. thick (*see actual block dimensions and explanation Fig. 7.*). Concrete block are also available in 4, 6, 10 and 12-in. widths. Another common size is the nominal 5x8x12-in. unit called a building tile, which is laid in courses 5 in. high and builds walls 8 or 12 in. thick according to the way the unit is placed. It is also available in 4-in. width. In some parts of the country the 3½x8x12-in. unit is available. It is laid in courses 3½ in. high and either 8 or 12 in. thick. Regardless of what type of concrete masonry unit is available locally, the products manu-

STEPS IN BUILDING CONCRETE MASONRY WALL

Vertical edges of the block are buttered with portland cement mortar before laying in wall.

Block is held in this manner and shoved firmly against the one previously placed, care being taken to set the block level.

Two rows of mortar are placed on wal[l.]
Outside top edge of block is set lev[el]
with and just touching chalk line.

EMPHASIZING HORIZONTAL JOINTS PRODUCES AN INTERESTING WALL

1—Mason rubs the vertical joint with a flat fragment of concrete unit to compact the mortar and obscure the joint.

2—Mason grooves the mortar with a round tool to emphasize the horizontal joint.

3—Close-up of wall section shows how vertical joints are obscured and horizontal joints brought out. Wall is finished with two coats of portland cement paint.

facturer carries in stock corner returns, door and win dow jamb units, joist units, half-length units, and other specials which enable the mason to construct rapidly a neat, attractive wall. Common shapes and sizes of concrete masonry units are illustrated in Fig. 7.

How to Build With Concrete Masonry

In general, it is best practice to employ an experienced mason to build concrete masonry walls, especially for the more important structures. In small, less important work any man handy with tools can soon acquire the necessary experience to lay concrete masonry units. Follow these simple rules:

1. Check the footing or foundation wall to see that it is level and straight, then stretch chalk lines along the outside edges of the walls to serve as guides in building the corners.
2. Build corners 2 or 3 courses high, then stretch chalk lines between corners along outside faces to serve as guides in laying the walls.
3. Place a double row of mortar on the footing or foundation wall as shown in accompanying illustration. This provides what is called "face shell bedding".
4. Press concrete masonry units carefully into the mortar with outer face touching the chalk or guide line.
5. Butter vertical edges of units with mortar and shove firmly against unit previously placed. Where large units are used it is customary to stand them on end and butter edges before placing in wall.
6. Vertical joints should average about $\frac{1}{4}$ to $\frac{3}{8}$ in. thick. Horizontal or bed joints should be not more than $\frac{1}{2}$ in. thick and should average about $\frac{3}{8}$ in. thick. Excess mortar which is squeezed out between joints as the units are placed should be struck off flush with the wall surface with a trowel.
7. After the mortar has become quite stiff, it should be pointed with a small trowel or rounded pointing tool which compacts the mortar, pressing it firmly against the concrete masonry units. This helps produce tight, strong joints.
8. Keep concrete masonry units dry until laid in the wall.

Some very interesting wall finishes can be obtained by varying the treatment of the mortar joints. A simple yet attractive finish is produced by tooling the horizontal joints to make them stand out prominently and by cutting off the vertical joints flush with the wall surface, then rubbing them with a piece of carpet, cork or other rough material to give them about the same texture as the concrete masonry units. Then when the wall is painted with portland cement paint the attractive finish with bold horizontal lines shown in illustration at left is obtained. Four other attractive wall treatments or patterns for concrete masonry construction are shown in Fig. 8. In these treatments, both horizontal and vertical mortar joints are tooled.

COMMON SHAPES AND SIZES OF CONCRETE MASONRY UNITS

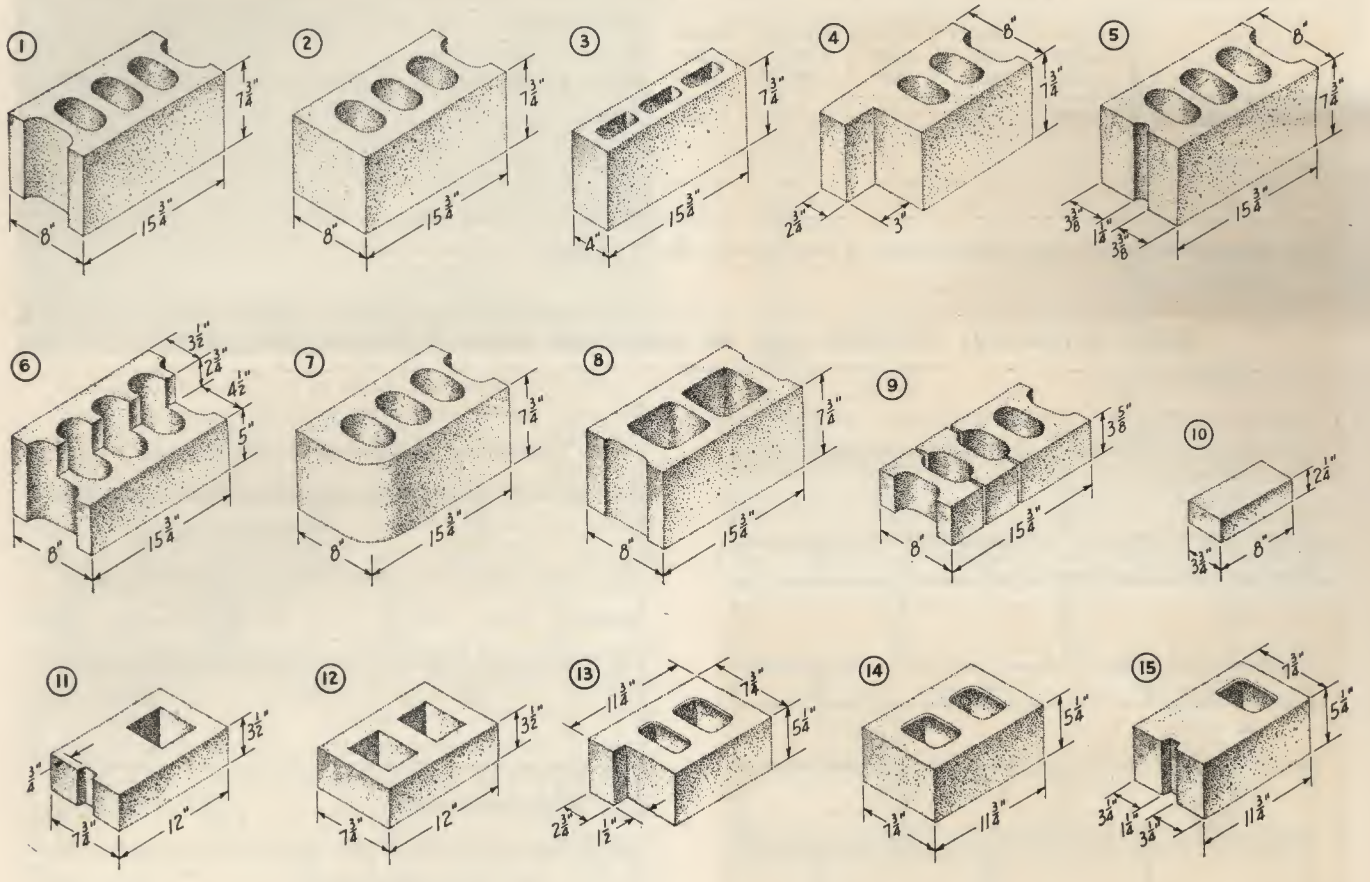


FIG. 7. (1) Three-core, full length block. (2) Corner return block. (3) Partition wall block. Also used in double wall construction. (4) Door and window jamb block for wood sash and frames. (5) Jamb block for metal sash. (6) Header block to back up brick and other facings. (7) Bullnose block for streamline corners. (8) Two-core block available in some areas. (9) Half-height block for ashlar walls. (10) Concrete brick. (11) Jamb tile for metal sash. (12) Full-length tile—3½-in. height. (13) Jamb tile for wood sash and frames. (14) Full-length tile—5¼-in. height. (15) Jamb tile for metal sash. As shown in the drawings, *actual* dimensions are ¼ in. less in length and height than *nominal* dimensions. Units are made this way so that a 7¾x8x15¾-in. unit plus one bed joint and one vertical joint will occupy 8x8x16-in. space when laid in the wall. Even dimensions are convenient in laying out the building and in using stock sizes of windows, doors and other millwork. Units shown are available in half-lengths and frequently in quarter and three-quarter lengths to save cutting on the job. Units (1), (2), (4), (5), (7), (8) and (9) are also available in 6, 10 and 12-in. widths. Units (11), (12), (13), (14) and (15), in 4-in. width.

Table V—Materials Required for 100 Sq.Ft. of Concrete Masonry Wall

	7¾-in. course height	5¼-in. course height	3½-in. course height
Wall thickness, in.	4 or 8	4 or 8	4 or 8
Number units (block)	110	220	300
Mortar, cu.ft.	3¼	5	6

Table VI—Materials Required for 100 Cu.Ft. of Mortar

Type of mortar	Sacks of cement	Lime, cu.ft.	Sand (damp-loose), cu.yd.
1 vol. cement to 3 vol. sand	32	.....	3.5
1 vol. cement to 3 vol. sand plus ¼ vol. lime.	29	6.7	3.5
1 vol. cement to 1 vol. lime to 6 vol. sand	16	16	3.6

Table VII—Weights and Time Required to Build 100 Sq.Ft. of Masonry Wall*

Wall thickness	7¾-in. course height				5¼-in. course height				3½-in. course height			
	4 in.		8 in.		4 in.		8 in.		4 in.		8 in.	
	Light aggregate	Heavy aggregate	Light aggregate	Heavy aggregate	Light aggregate	Heavy aggregate	Light aggregate	Heavy aggregate	Light aggregate	Heavy aggregate	Light aggregate	Heavy aggregate
Weight of wall—lb.	2,200	3,450	3,600	5,850	1,800	2,700	3,050	4,900	2,100	3,050	3,600	5,550
Mason time—hours	2½	3	3¼	3¾	3	3¼	3½	4	2¾	3	3½	4
Labor time—hours	2	2½	3	3½	2½	2¾	3¼	3¾	2¼	2½	3¼	3¾

*Light aggregate includes cinders, expanded slag or burned shale. Heavy aggregate includes sand, gravel and limestone.

MANY ATTRACTIVE PATTERNS CAN BE PRODUCED WITH CONCRETE MASONRY

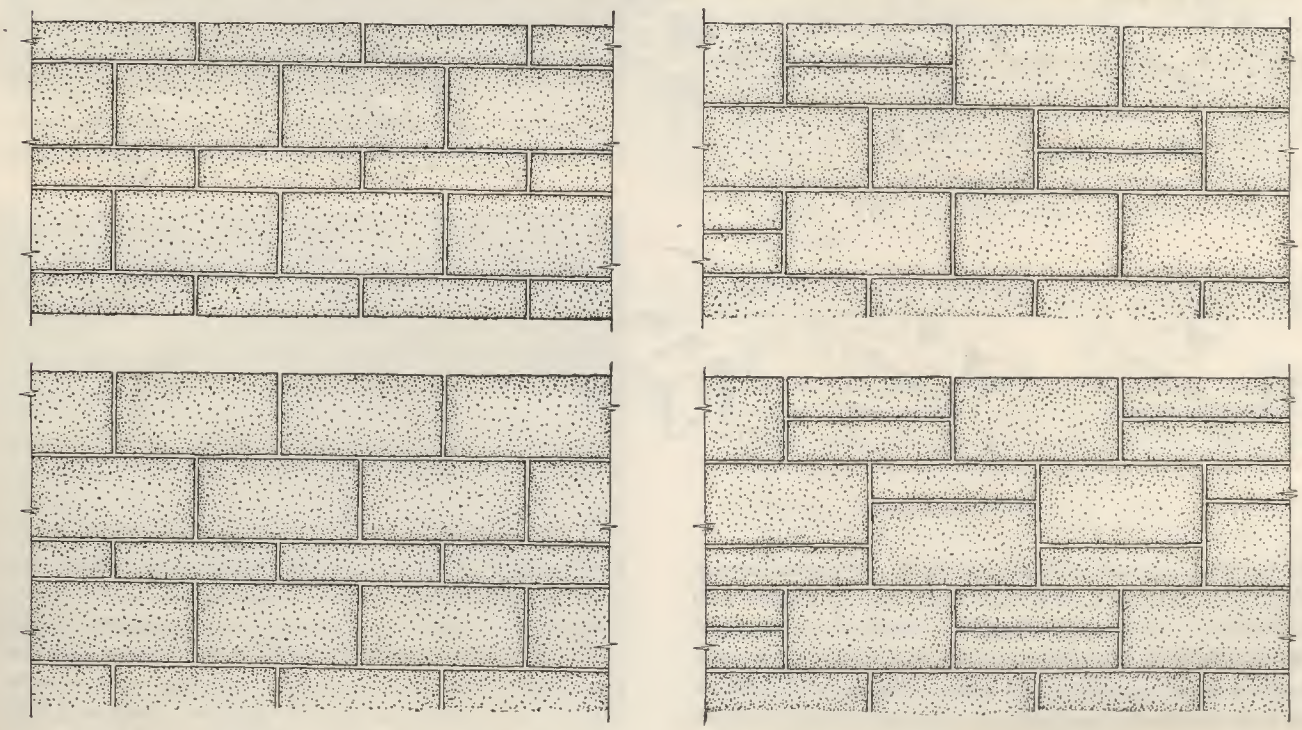


Fig. 8. These and many other patterns can be obtained by combining full and half-height concrete masonry units.

Mortar to Use

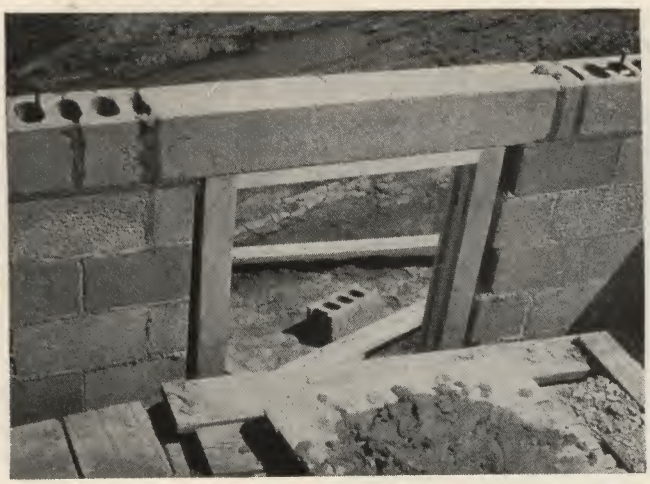
For laying concrete masonry walls subject to average loading and exposure, use a mortar made in the proportions of 1 volume of masonry cement* and between 2 and 3 volumes of damp, loose mortar sand; or 1 volume of portland cement and between 1 and 1¼ volumes of hydrated lime or lime putty and between 4 and 6 volumes of damp, loose mortar sand. Walls which will be subjected to extremely heavy loads, violent winds, earthquakes, severe frost action, or other conditions requiring extra wall strength, including isolated piers, should be laid with a mortar made of 1 volume of masonry cement* plus 1 volume of portland cement and between 4 and 6 volumes of damp, loose mortar sand; or 1 volume of portland cement, to which may be added up to ¼ volume of hydrated lime or lime putty, and between 2 and 3 volumes of damp, loose mortar sand. Add sufficient water to obtain a workable mortar. For estimating quantities, see Tables V and VI.

*Federal Specifications SS-C-181b, Type II.

Concrete Sills and Lintels

Common types of concrete sills and lintels are shown in Fig. 9.

Concrete lintels are used over door and window openings. Lintels are usually 8 in. wide and 7¾ in. high to fit into walls of 8x8x16-in. units. They may be precast or made on the job. Lintels which carry only wall loads and are not over 3 ft. long do not require reinforcement. Lintels from 3 to 8 ft. long which carry only wall loads are reinforced with two ⅜-in. round bars placed 1½ in. above the bottom of the lintel. Where lintels carry both wall and floor loads, it is best to obtain the advice of a structural engineer as to the amount of reinforcement to use. A concrete lintel should usually have an 8-in. bearing on the wall on each side of the window or door opening.

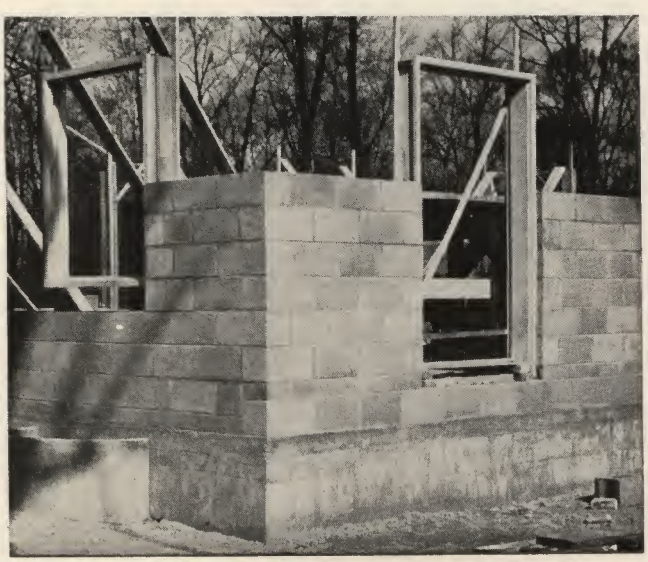


Precast concrete lintel in place over window frame.

Other Construction Details

Window and door frames are readily built into the wall. They are temporarily braced in position before walls on either side are built, care being taken that top of window or door frame is placed at the exact course height where lintels are to be installed. Tight construction along sides of the frame is obtained by using special jamb units made for this purpose. After walls on either side of window and door frames have been built up to the top of the frames the concrete lintels are set in place.

Serviceable door frames and window frames for small farm buildings may be made of 2x6 material. Window frames of this kind are shown in Fig. 9; door frames in Fig. 10. Width of window and door openings and distance between openings should, for greatest convenience, be some even multiple of 4 in. Thus, masonry openings 24, 28, 32, 36 or 40 in. wide are provided by using conventional full-size block 16 in. long together with three-quarter, half and quarter-length units.



Window and door frames should be carefully plumbed and braced in position before wall units are laid.

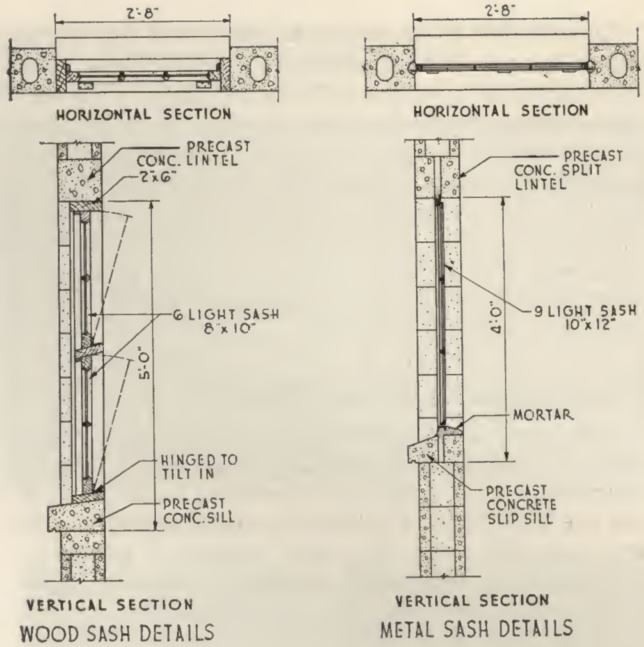


FIG. 9. Wood sash and metal sash details. Concrete sills and lintels should be used for all window and door openings.

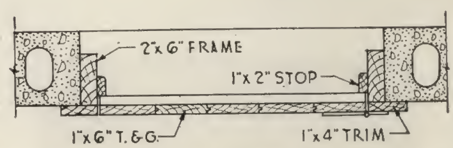


FIG. 10. A method of building door frames which is suitable for most service buildings.

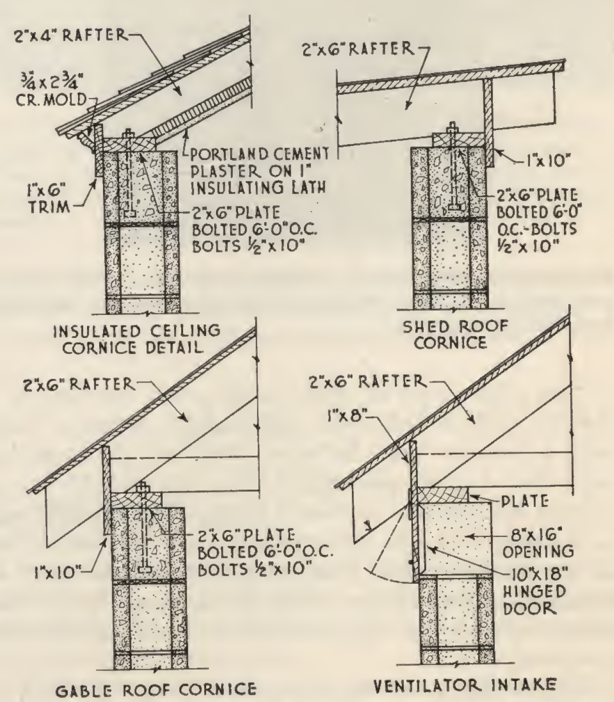
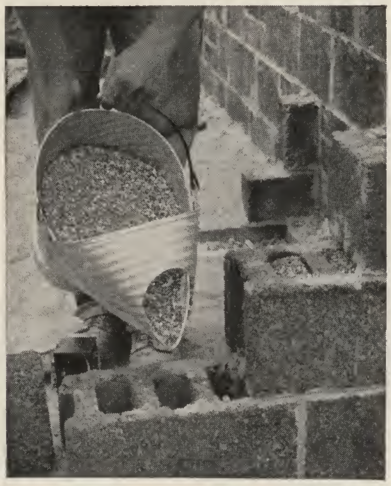


FIG. 11. Suggested types of construction at cornice and plate level.

Construction at the cornice or plate level may be as shown in any of the drawings in Fig. 11. Thus, usual construction is to anchor a 2x6 or 2x8 plate to the concrete masonry wall with ½-in. by 8-in. or 10-in. bolts set approximately 6 ft. on centers. Weatherproof construction is obtained by fastening a 1-in. board over the joint between plate and wall as shown. Boards required will be 1x6, 1x8 or 1x10 depending on the size and cut of rafters. For a trim, modern appearance, exterior crown molding may also be applied under the eave as shown in one of the drawings.

Lightweight Concrete Masonry

With more and more attention being given to well-insulated homes and livestock buildings, many farmers are building with lightweight insulating concrete block and tile. Two types of insulated concrete masonry walls are commonly used. One type consists of 8x8x16-in. block made of lightweight aggregate concrete. Lightweight concrete is made with such aggregates as cinders, expanded slag, and expanded burned shale. The insulating value of this wall may be increased if desired by filling the cores in the units with a granular insulating material. Such a wall provides all the insulation needed for walls of livestock shelters even in the northernmost areas in the United States.



Increased insulation of concrete masonry walls may be provided by filling cores in the units with a granular insulating material.

The other type of wall construction consists of a double wall of 4x8x16-in. lightweight concrete block with a 1-in. air space between. Walls are tied together with No. 6 gage galvanized wire ties laid 24 in. on centers in alternate courses of block. Wire ties are bent in the shape of a 5-in. square and are carefully embedded in the mortar joints. Further wall insulation may be obtained, if desired, by filling the 1-in. air space with granular insulation. This provides an exceptionally well-insulated wall.

Lightweight concrete block should not ordinarily be used below grade; usual practice is to use heavyweight concrete block or cast-in-place concrete.

Estimating Concrete Masonry Unit Requirements

If you will take your plans to your local concrete products plant which manufactures concrete building units you can get an estimate of the number of units required including full-length units, half units, corner units, jamb units and other specials. You can also get information on the amount of mortar required to build the walls as well as information on sills and lintels and much other helpful advice.

Applying Portland Cement Paint

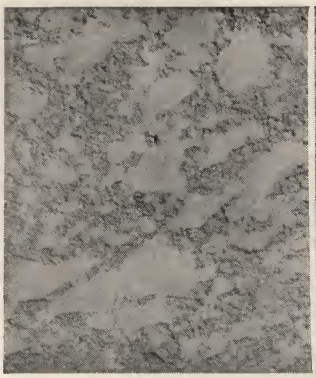
Concrete masonry walls take on an attractive, fresh, clean appearance when painted with portland cement paint. Portland cement paint also forms a weathertight coating over the surface which resists the penetration of rain through the walls.

Factory-mixed portland cement base paints should meet the requirements of Federal Specifications for Paint; Cement-Water, Powder, White and Tints (For Interior and Exterior Use), Designation TT-P-21. Manufacturers' directions should be closely followed in mixing and applying cement paint.

In general the following steps are recommended in applying portland cement paint.

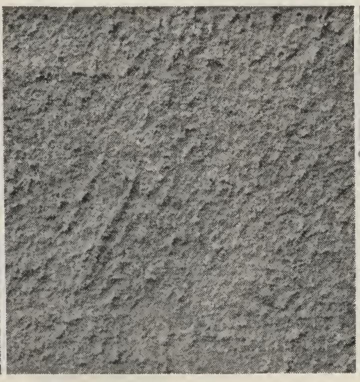
1. Cement paint comes in powder form and is mixed with water to a painting consistency just before applying. Paint should be thick enough so that it will not run when applied and yet not so thick that it cannot easily be scrubbed into the surface. The first coat is usually mixed to a thinner consistency than the second coat so that it can be scrubbed into the numerous small apertures in the wall surface.
2. The paint powder and water should be thoroughly mixed together and the mixture stirred occasionally to keep the powder from settling to the bottom of the container.
3. The surface to be painted should be uniformly wetted with water. This water is best put on as a fine spray. Garden spraying equipment is excellent for this purpose.
4. The paint is applied immediately to the damp surface. Joints are covered first, after which the entire surface is gone over using a scrubbing motion of the brush to make sure that the paint is worked into small openings, thoroughly covering the surface. If this is not done, pin holes are likely to be left in the surface through which rain water may pass.
5. A brush with short stiff bristles is recommended. Brushes with long bristles or fibers should not be used. A scrub brush with bristles about 2 inches long is most satisfactory.
6. As soon as the paint has hardened sufficiently so that it will not wash it should be sprayed with water as often as necessary to keep the surface damp. Cement paint needs moisture to harden properly. The second coat is cured in a similar manner. Curing should be continued for 24 hours. It is best to apply paint on the shady side of a building in warm sunny weather. Then the fresh paint will not be exposed to direct drying action of the sun.
7. The second coat is applied after the first coat has hardened, usually in about 24 hours. The surface is uniformly dampened just ahead of painting and the painted surface is cured as described above.

A FEW OF THE MANY ATTRACTIVE STUCCO TEXTURES COMMONLY USED

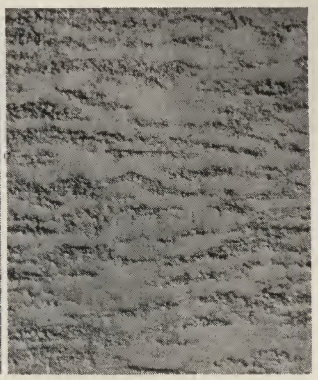


Italian

English Cottage



Spatterdash



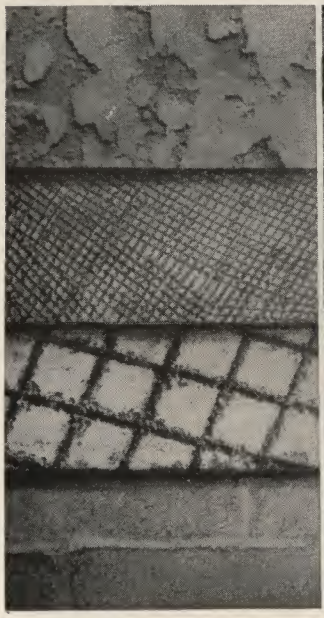
Travertine

Stucco Finishes

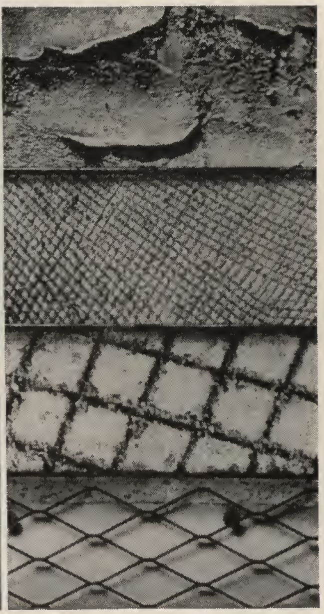
If the owner prefers, he may have his concrete masonry buildings finished with portland cement stucco. Stucco finishes can be produced in a wide selection of textures and colors. A few typical textures are illustrated above.

Concrete masonry walls provide an unexcelled base for stucco. Three-coat work is recommended, consisting of a first or scratch coat, a second or brown coat and a finish coat. The first two coats are each about ⅜ in. thick and the finish coat from ⅛ to ¼ in. depending upon the texture selected. Mortar for all coats is mixed in the proportions of 1 sack of portland cement to 3 cu.ft. of moist sand to which not more than 10 lb. of hydrated lime or lime putty can be added to give the mortar the required plasticity to spread readily. If color is desired in the finish coat it is obtained by adding the proper amount of a mineral oxide pigment of the required color. For light colored finishes use white portland cement.

Before applying the first or scratch coat the concrete masonry wall should be dampened to insure a good bond. The second coat is applied not sooner than 24 hours after the first coat. The first coat should be scratched to help provide better bond for the second coat which is also scratched to provide bond for the final coat. The final or finish coat should not be put on sooner than 7 days after the second coat. Plaster coats should be kept constantly moist for at least 2 days by sprinkling to aid in curing. A competent plasterer or stucco contractor should be employed to be assured of a quality job that will give long-lasting service.



Portland cement stucco is applied directly on concrete masonry walls. Scratch coat, second and finish coats shown.



On frame construction, portland cement stucco should be applied to expanded metal lath properly secured.

Insulating Farm Buildings

Keeping heat or cold in or out of a building in an effort to maintain a uniform temperature is the purpose of insulation.

The two types of insulation most commonly used in farm buildings are rigid board and fill. The rigid board type is used in cast-in-place concrete walls, fill is used in hollow masonry walls.

In the colder climates animal shelters must be insulated. Most animals produce enough heat to maintain a comfortable indoor temperature if the heat is not lost through the walls and roof.

Insulation must be kept dry to be of greatest value. In barns, poultry houses, milk houses or other buildings where the humidity becomes relatively high moisture vapor condenses on cold surfaces and if allowed to pass into a wall, moisture accumulation in the wall will result. It is important therefore, that with the fill-type insulation in a wall a moisture seal be placed on the inside or warm side of the wall. Aluminized asphalt paint as well as other waterproof coatings are used for this purpose. Rigid-board-type insulation may be obtained which has a waterproof seal.

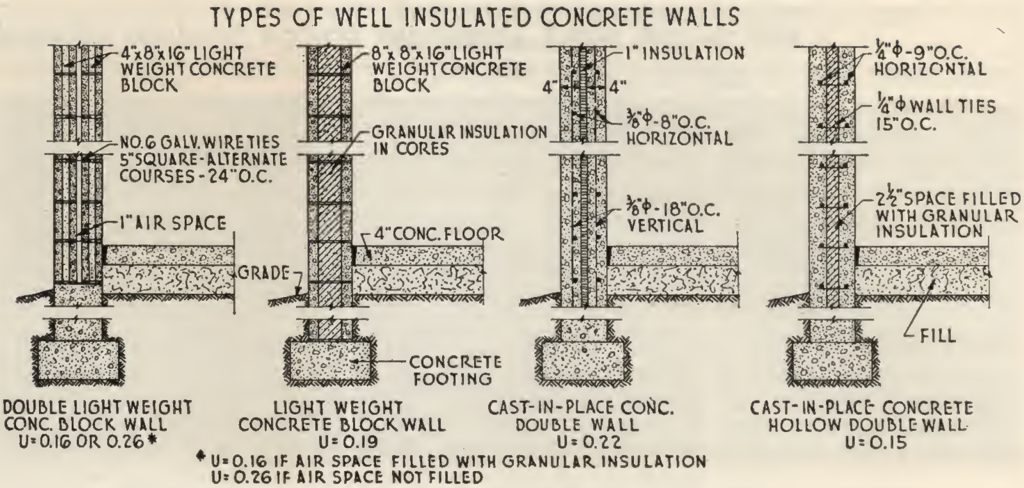


FIG. 12. Types of well-insulated concrete walls.

Concrete masonry or reinforced concrete walls in farm buildings can be designed for low thermal conductivity, that is, for low heat loss through the wall. Tests sponsored by the American Society of Heating and Ventilating Engineers in cooperation with the Portland Cement Association showed coefficients U ranging from 0.30 down to 0.10 depending on wall thickness, kind of aggregates and method of wall insulation.

Lightweight concrete blocks are widely used for wall construction because of their low thermal conductivity. When additional insulation is needed the cores of the blocks are filled with fill-type insulation as illustrated on page 14.

Types of walls and methods of insulating them are shown in Fig. 12. The heat loss through walls, however, may not be as large as that through the roof, and it is therefore very important that this loss be considered and steps taken to reduce it. Hay in mows gives good insulation; the straw loft in the poultry house also gives good protection. The plans for the 1-story dairy barn and milk houses on pages 22 and 26 show other economical methods of insulating roofs.

Barns—General Purpose and Dairy

How to Choose the Barn Plan

The farmer should always select the barn plan which best fits his own needs.

Inspection of barns already constructed or study of up-to-date plans is suggested before construction is started. Costly mistakes often can be avoided and more serviceable buildings obtained in this way.

Complete plans and details of construction in blueprint form for the barn layouts illustrated may be had free upon request in the United States and Canada. With minor changes these plans usually can be made to fit the needs of most farms.

Barns should be located with long axis north and south to obtain maximum amount of sunlight. The hay

Well-insulated and well-ventilated 1-story concrete barns provide warm, dry quarters for most efficient production. In addition they are completely firesafe. Separate hay storage is provided nearby.

door should be placed on the north; this permits unloading in the shade. Flat and gable roofs are used on 1-story barns while Gothic or gambrel roofs are used most for 2-story barns.

The barn design data which follow represent the general recommendations of leading farm building specialists and can be used either in planning new buildings or for remodeling.

BARN DESIGN DATA

Dairy Barns

Light = 4 sq.ft. of window area per cow
Stall width = 3 ft. 6 in. (may vary 3 ft. 2 in. to 3 ft. 8 in.)
Stall length = 4 ft. 8 in. (may vary 4 ft. 6 in. to 5 ft. 4 in.)
Feed alley width = 4 ft. 0 in. (may vary 3 ft. 0 in. to 5 ft. 0 in.)
Manger width = 2 ft. 6 in. (may vary 2 ft. 0 in. to 2 ft. 8 in.)
Litter alley width = 5 ft. 0 in. (4 ft. 6 in. to 8 ft. 0 in. for driveway)
Cross alleys width = 3 ft. 6 in. (not less than 3 ft. 0 in.)
Bull pen size = 9x9 ft. or larger
Calf—or young stock pen = 7x7 ft. or larger—best to be 10 to 12 ft. wide
Mows should provide 2 tons (1,000 cu.ft. storage space) for each cow
Mows should provide 1 ton (500 cu.ft. storage space) for each cow where 4 to 6 months' pasture or silage is provided

Horse and General Purpose Barns

Single horse stall width = 5 ft. 0 in. (may vary 4 ft. 8 in. to 5 ft. 6 in.)
Double horse stall width = 9 ft. 0 in. (8 ft. 0 in. for small barns)
Manger width = 2 ft. 0 in.
Stall length = 7 ft. 0 in.
Litter alley width = 5 ft. 6 in. (5 ft. 0 in. to 6 ft. 0 in.) for 1 row of stalls or 10 ft. 0 in. for 2 rows with center alley
Extra doors = 4 ft. 0 in. wide or 3 ft. 4 in. to 8 ft. 0 in. double—all 7 ft. 4 in. high
Ceiling height underside of joists—7 ft. 6 in. to 8 ft. 0 in. for dairy barns
Ceiling height underside of joists—8 ft. 0 in. to 9 ft. 0 in. general purpose—beef and horse barns

Dairy and General Purpose Barns

Generous hay storage 2 to 2½ ton per cow.
Only 1 ton per cow or less if most of roughage is placed in silos, stacks, etc.

Floor Space in Mule Pens

60 to 70 sq.ft. per mule more or less.

The concrete floor is a recognized necessity in modern dairy barns.

Dairy Barns

A well-built concrete structure provides service for a lifetime or more. For this reason the arrangement of the floor space into stalls, alleys and pens should be carefully planned on paper before beginning construction. A careful study of floor arrangements permits selection of a plan which makes possible the saving of much time and labor in caring for the stock.

A double row of cow stalls is usually the most economical arrangement in dairy barns. Cows may face in or face out, according to dairyman's preference. Many dairymen favor the "face out" arrangement however, because it allows efficient work behind the cows where most of the work is done. Other advantages of the "face out" arrangement are that walls are not spattered with droppings, fewer doors are required, mangers are exposed to direct light, more efficient use is made of space for pens, box stalls, etc., and with this arrangement cows show off best. Advantages of "face in" arrangement are: better light for milking, more convenient feeding, supporting columns may be in stall rows.

The high, "feed saving" type of manger shown is preferred by most modern dairymen because of its sanitary features. Many health authorities object to the low,

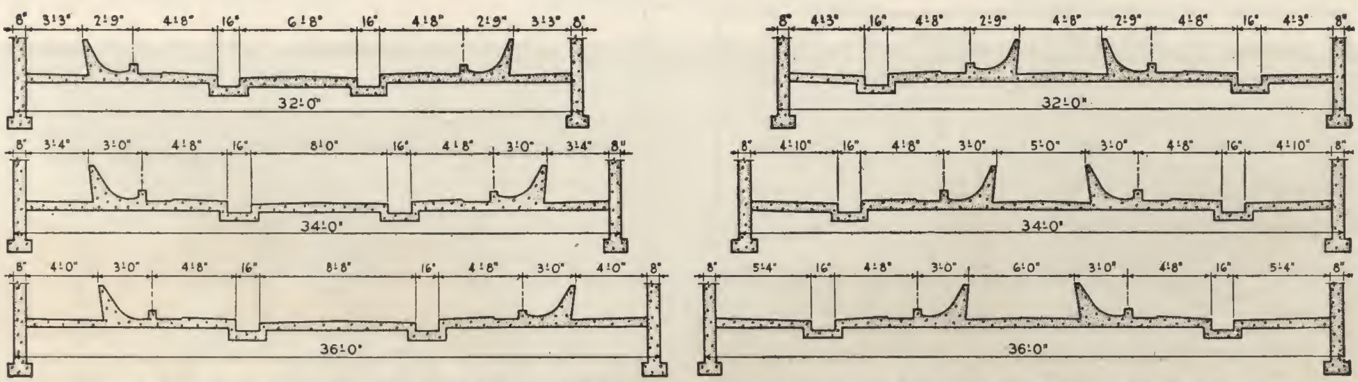


FIG. 13. Typical dimensions for dairy barns of different widths, cows facing in or facing out. See Table VIII.

One-story dairy barn constructed as addition to old barn. The concrete floor, lightweight concrete masonry walls and precast window sills and lintels make a serviceable and economical firesafe unit to house the dairy herd.

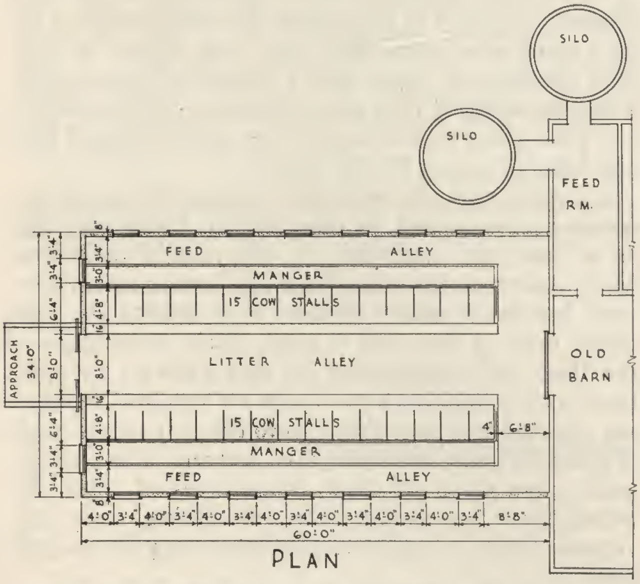


FIG. 14. Old barns can often be used for feed storage while cows are housed in a new 1-story addition.

Table VIII—Dimensions of Cow Stalls*

Breed	Approximate weight, lb.	Length of stall	Width of stall
Ayrshire	1,000	4 ft. 8 in.	3 ft. 6 in.
Brown Swiss	1,200	5 ft. 0 in.	3 ft. 8 in.
Guernsey	1,000	4 ft. 8 in.	3 ft. 6 in.
Holstein	1,200	5 ft. 0 in.	3 ft. 8 in.
Jersey	900	4 ft. 6 in.	3 ft. 5 in.
Shorthorn	1,400	5 ft. 4 in.	4 ft. 0 in.

*These are dimensions commonly employed for average size cows. Stall lengths for large cows may be increased 3 in.; for small cows decreased 3 in. Heifers require stalls about 3 ft. wide, 4 ft. long.

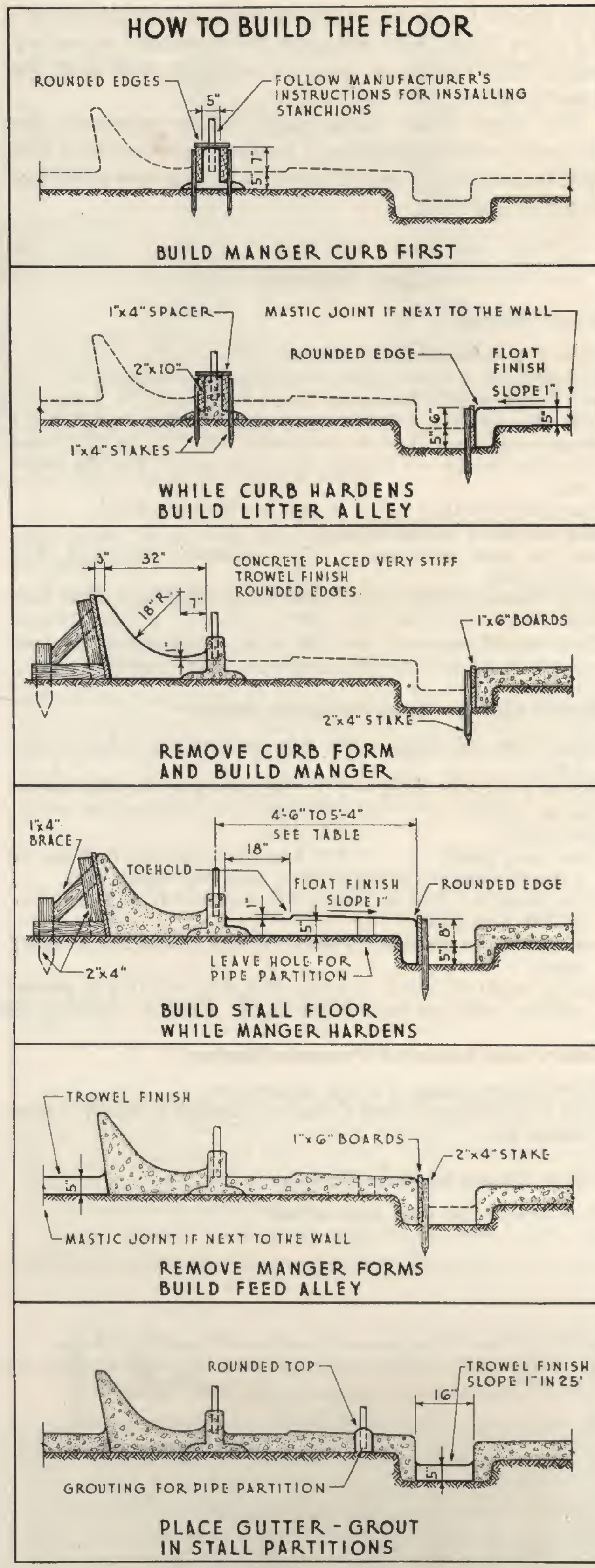


FIG. 15. Principal steps in building the dairy barn floor. Materials required for each 10 ft. of manger and curb are 7½ sacks of portland cement, 1 cu.yd. of sand and 1 cu.yd. of gravel.

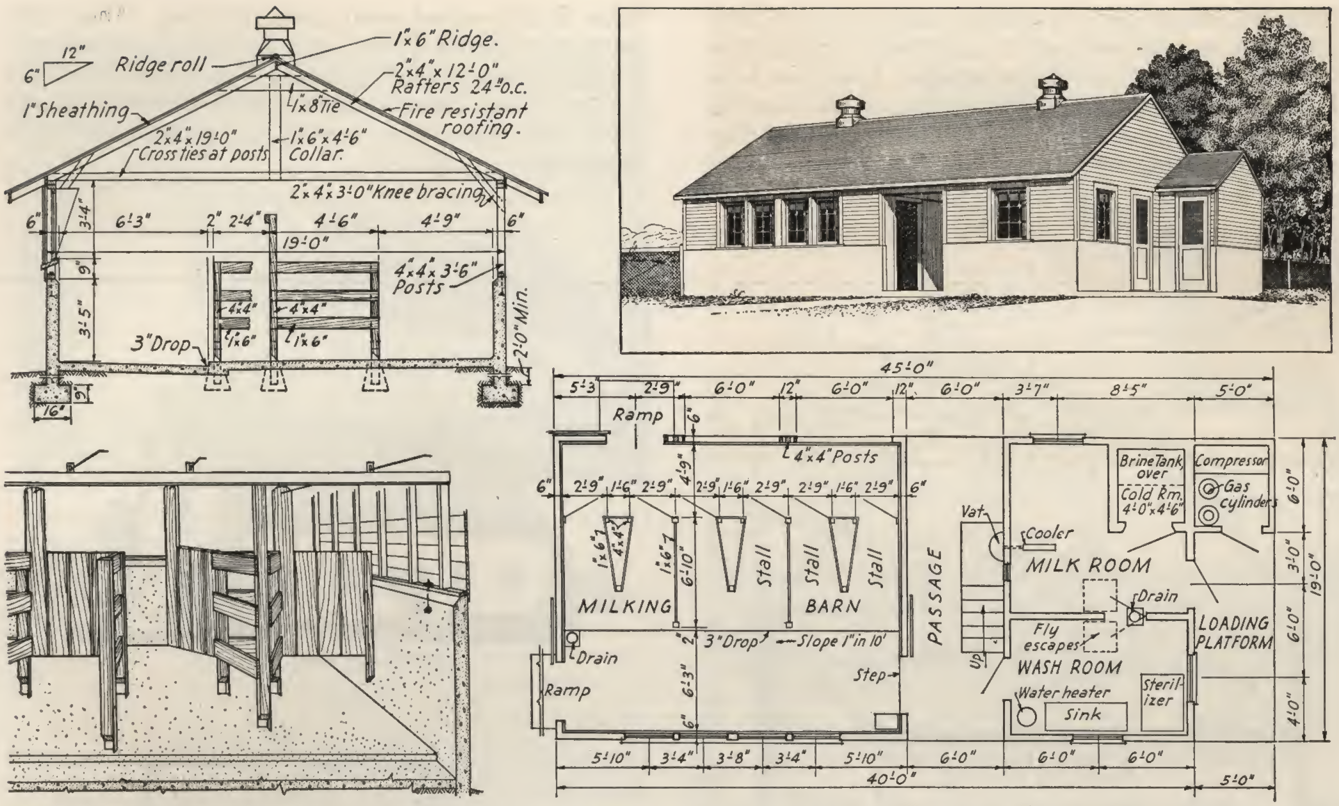


FIG. 16. In some sections the "walk through" type milking barn and milk house is popular. The cattle are fed and housed in a separate shelter barn, remaining in the "walk through" stalls only long enough to be milked. This plan provides for milking of 6 cows at a time which cares for a total herd as large as 60 cows.

"sweep-in" type of mangers and feed alleys on the grounds that they aid in the spread of disease.

The proper housing of dairy cows is good business because it leads to increased production. Moreover, if the barn is intelligently planned and constructed, the labor of feeding, milking and cleaning can be cut to a minimum.

Individual requirements determine whether the barn should be a 1, 1½ or a 2-story structure. Storing hay in silos, chopped or as green silage, makes 1-story barns adaptable on many farms. One-story additions may also be built on to existing barn to meet milk ordinance requirements.

Insulation and ventilation are necessary if dairy barns in northern areas are to be warm, healthful and reasonably dry in winter months. Types of well-insulated walls are shown on page 16. Inside wall surfaces of dairy barns should be painted with aluminized asphalt paint or some other effective vapor seal.

Adequate ventilation is also essential. With a well-

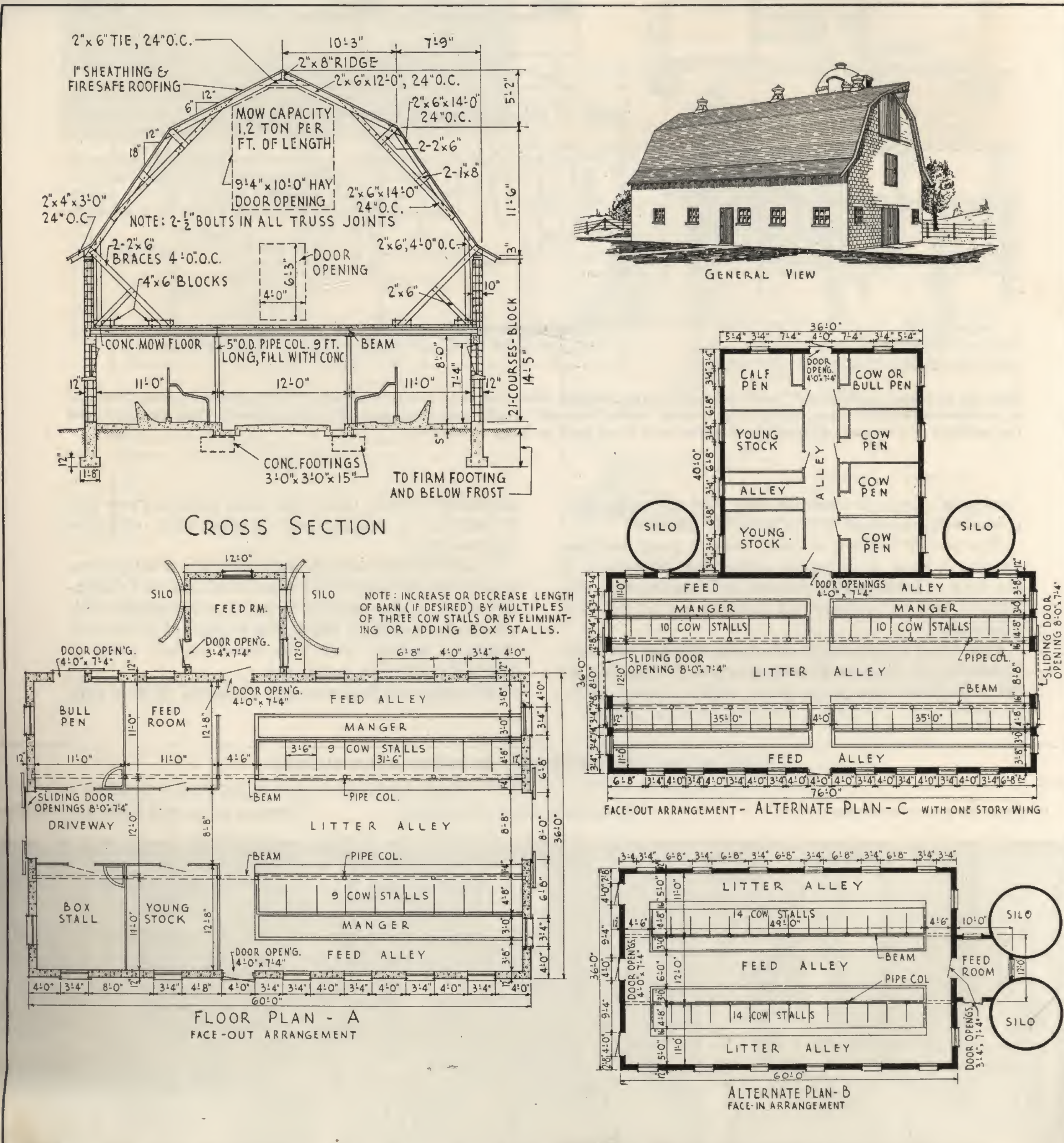
STEPS IN THE CONSTRUCTION OF DAIRY BARN FLOORS

Placing the concrete manger curb.

Forming in place for mangers.

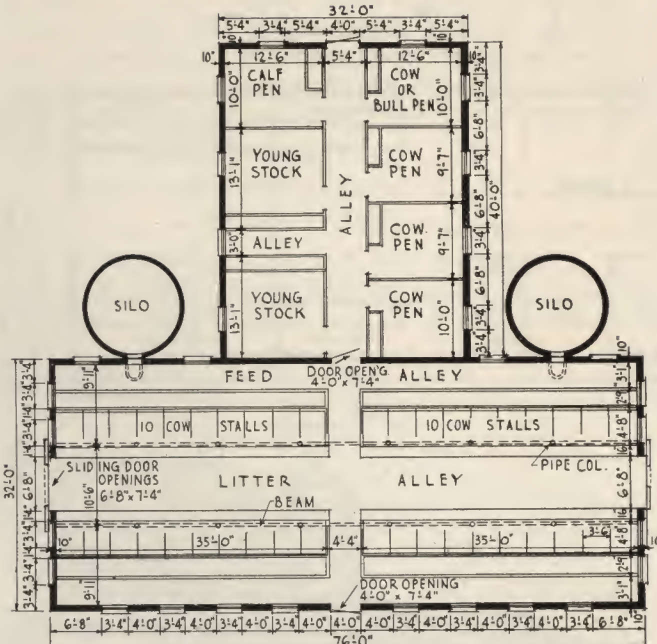
Forming curve with board and templets.

insulated and properly ventilated stable, cows will usually produce sufficient heat to maintain a temperature of 45 to 50 deg. F. in winter weather. Engineers have found that temperature control is one of the essential factors in successful ventilation. Generally the inlet flues should open into the building near the ceiling. Outlet flues should extend down near the floor. When electricity is available, forced draft ventilation can be used. Consult a ventilation specialist if in doubt about the system to use. Barn equipment manufacturers usually give free engineering service on problems of this character.

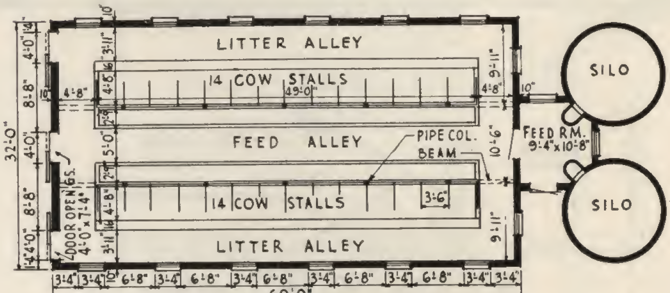


Dairy Barn. For details of construction ask for Plan C-2232.

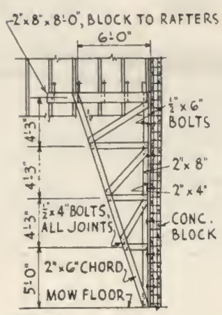
Typical Gothic roof barn with concrete masonry walls up to mow floor.



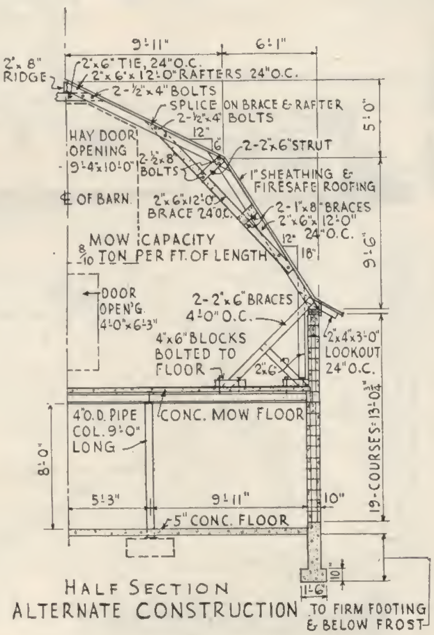
ALTERNATE PLAN - C WITH ONE STORY WING
FACE-OUT ARRANGEMENT



ALTERNATE PLAN - B
FACE-IN ARRANGEMENT

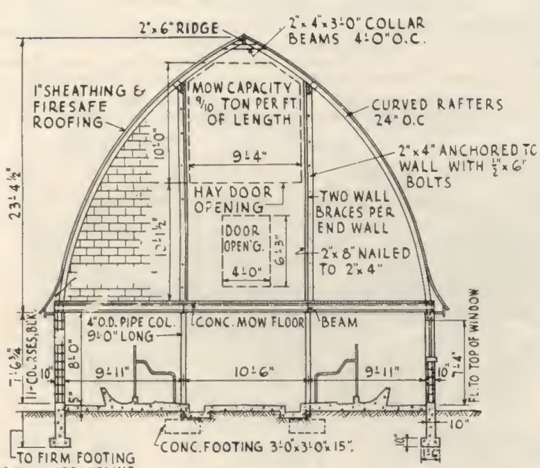


DETAIL OF END WALL BRACES 4-REQ'D.

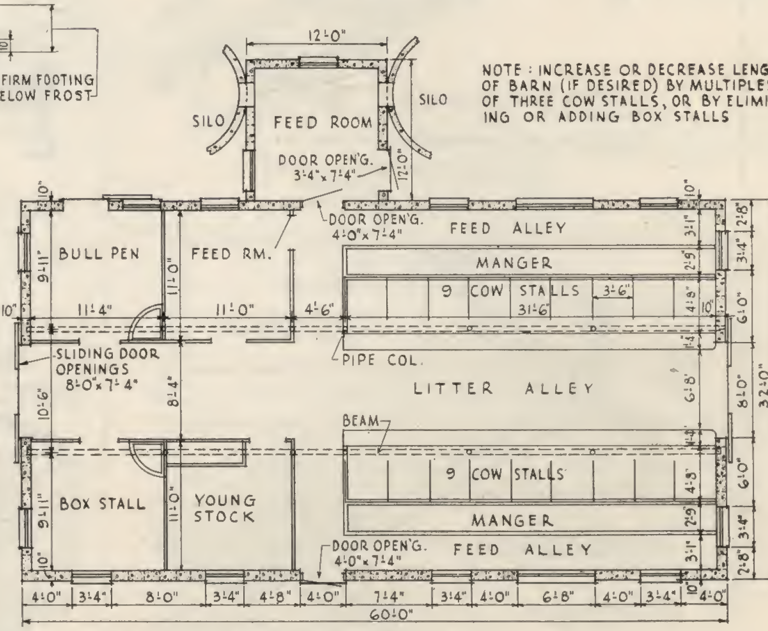


HALF SECTION
ALTERNATE CONSTRUCTION

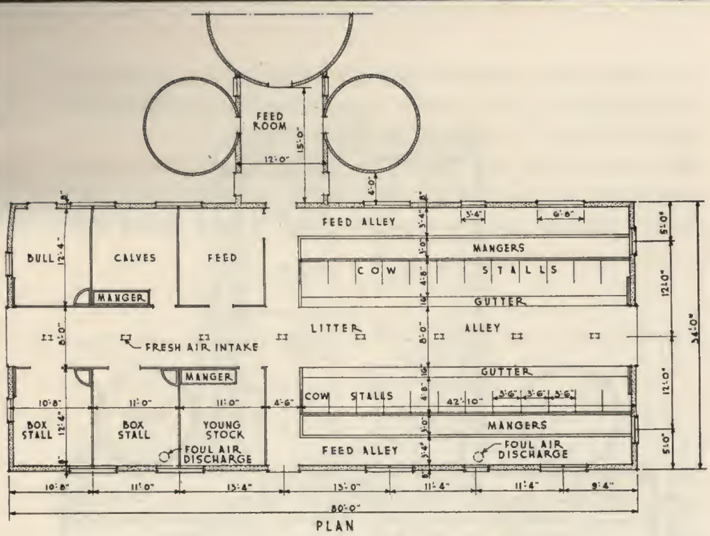
NOTE: INCREASE OR DECREASE LENGTH OF BARN (IF DESIRED) BY MULTIPLES OF THREE COW STALLS, OR BY ELIMINATING OR ADDING BOX STALLS

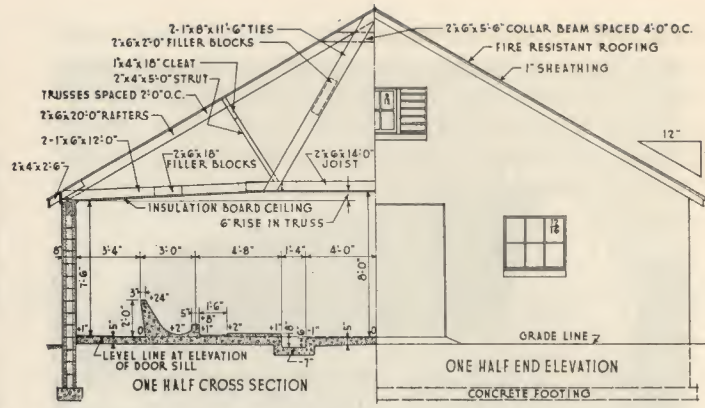


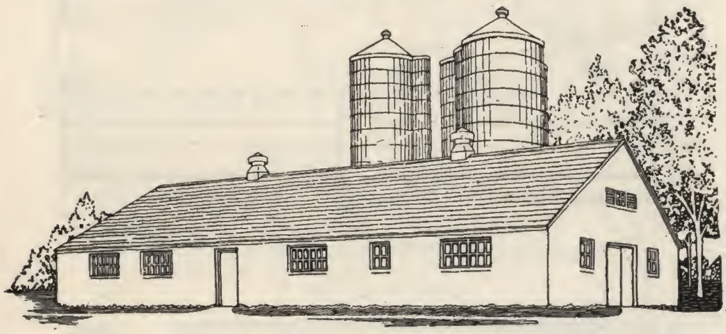
CROSS SECTION

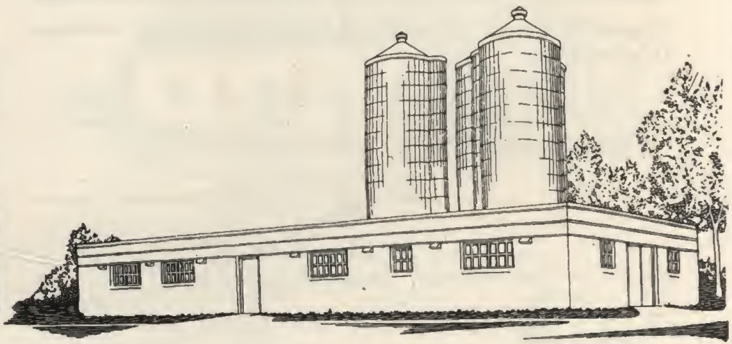


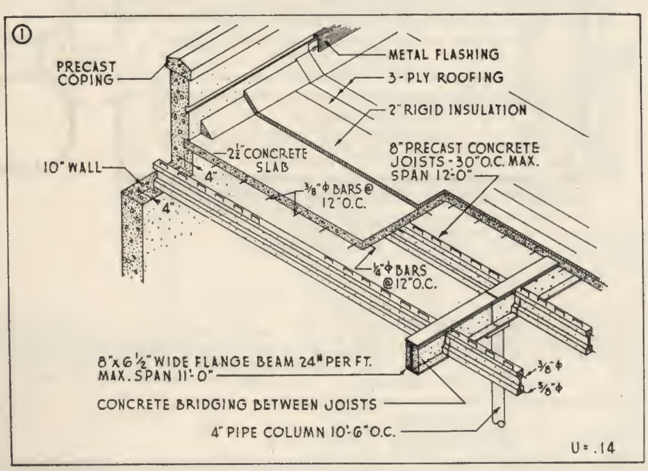
FLOOR PLAN - A
FACE-OUT ARRANGEMENT

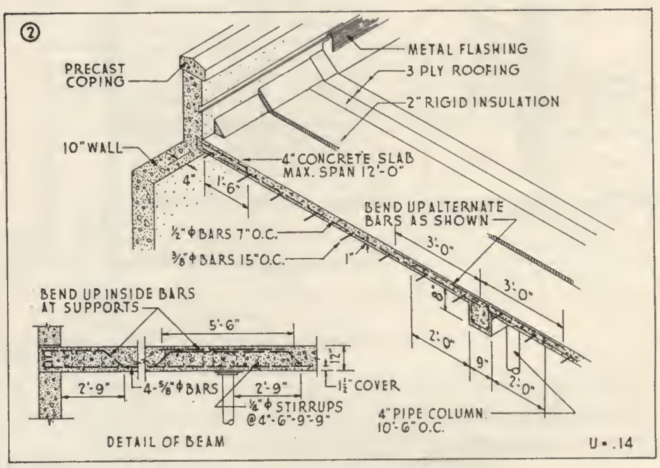


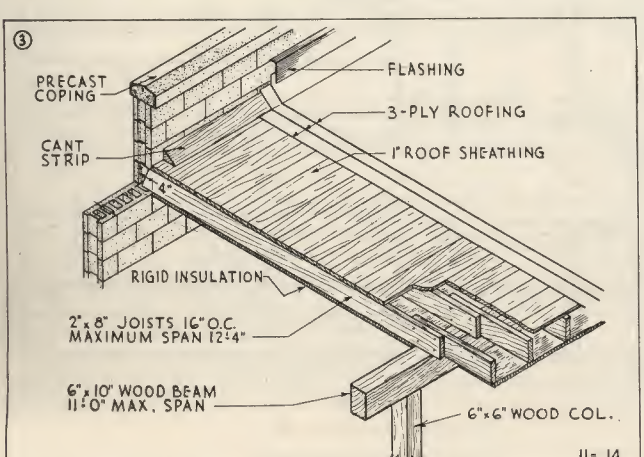


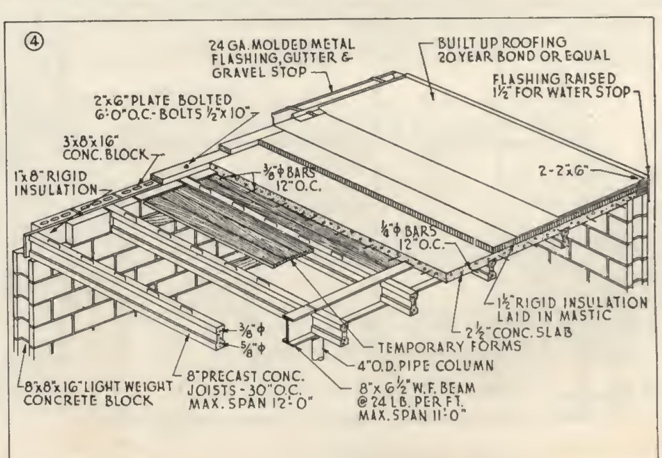












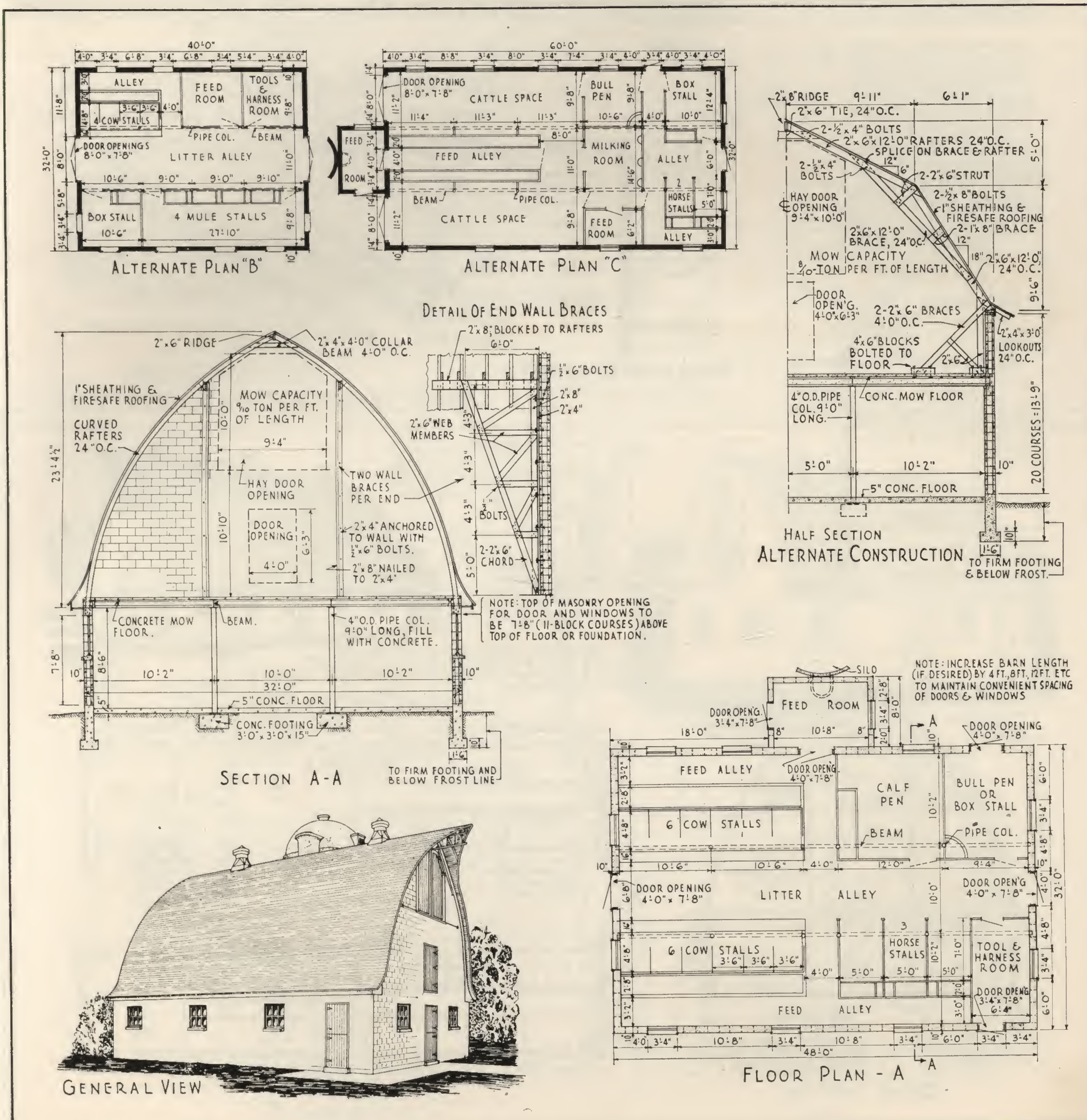
TYPES OF INSULATED FLAT ROOFS

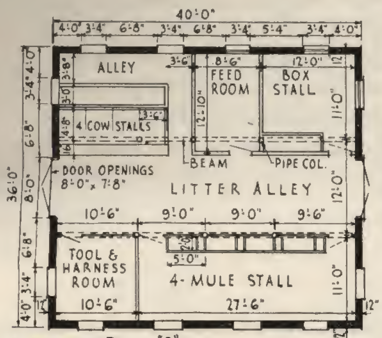
One-Story Dairy Barn with either flat or gable roof. For details of construction ask for Plan C-2486 for gable roof or C-2487 for flat roof.

General Purpose Barns

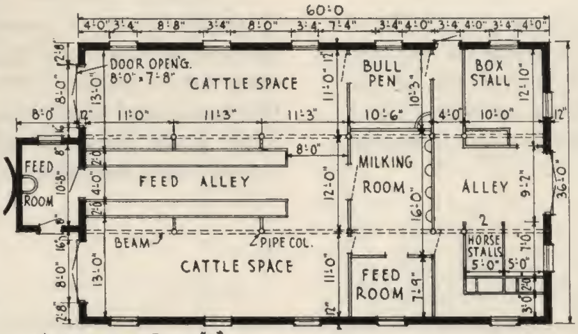
The size and floor plan of the general purpose barn depend entirely upon individual requirements. Several alternate floor plans which meet requirements of the majority of general farmers are shown on pages 23 to 25. Slight changes can be made to fit the plans to special conditions.

A general purpose barn should be planned and arranged to meet present needs and should also be planned so that with minor changes it can be made to meet future needs. Future changes in type of power on the farm must be considered in planning the barn. Two horse stalls may be converted into 3 cow stalls for future use if desirable.

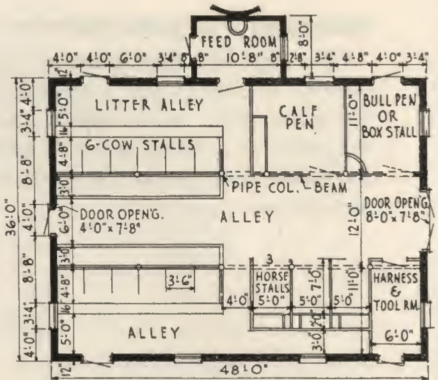




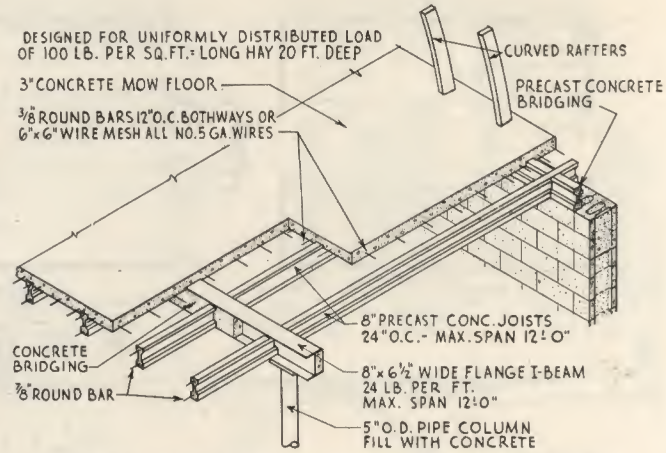
ALTERNATE PLAN-"B"



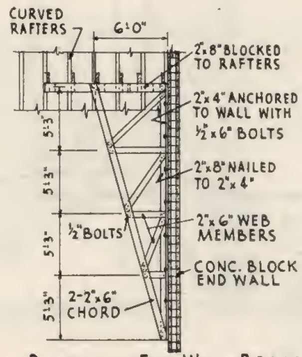
ALTERNATE PLAN-"C"



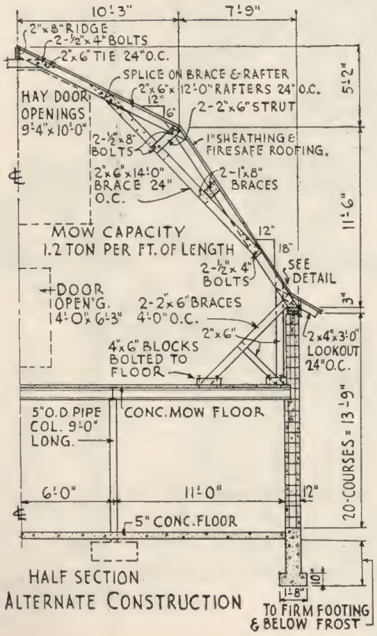
ALTERNATE PLAN-"D"



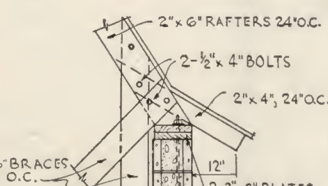
PRECAST CONCRETE JOIST AND SLAB MOW FLOOR



DETAIL OF END WALL BRACES

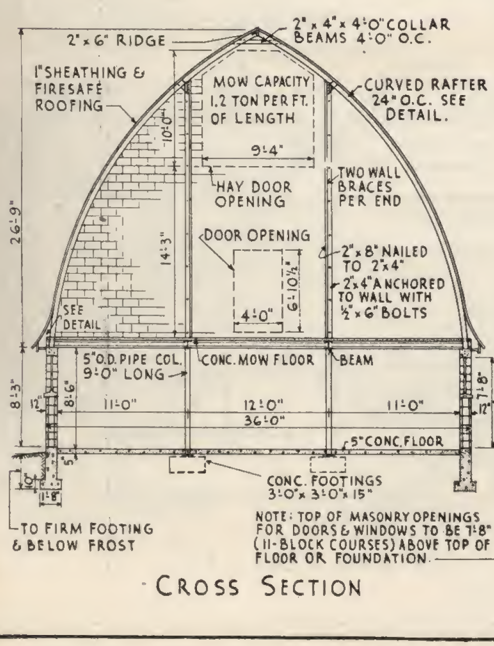


HALF SECTION
ALTERNATE CONSTRUCTION



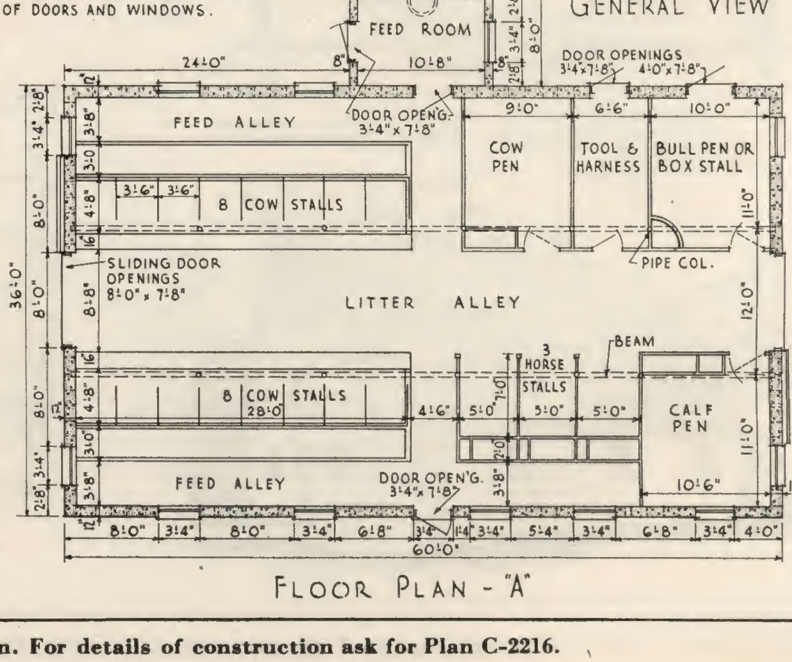
DETAIL AT PLATE

GENERAL VIEW



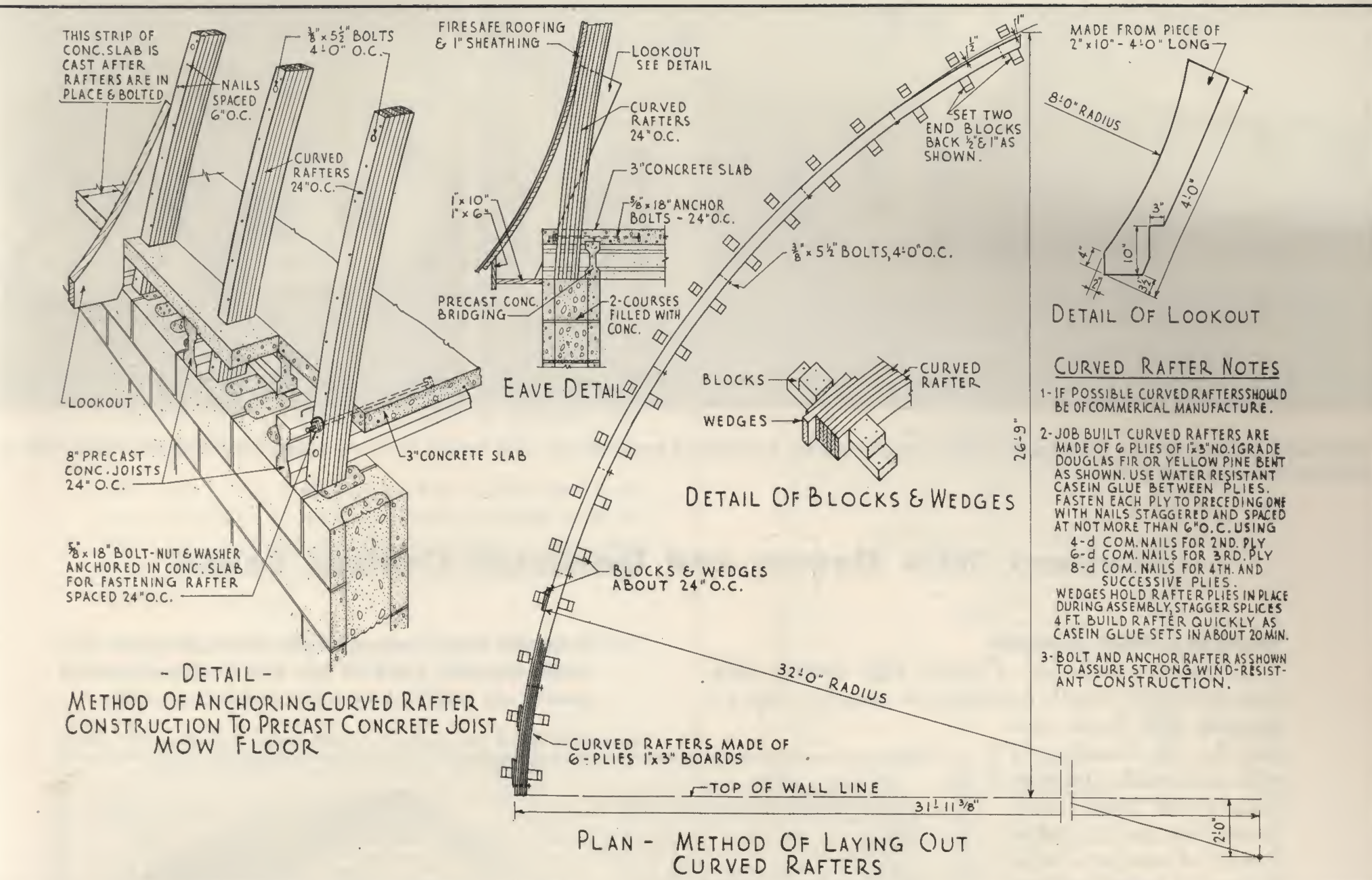
CROSS SECTION

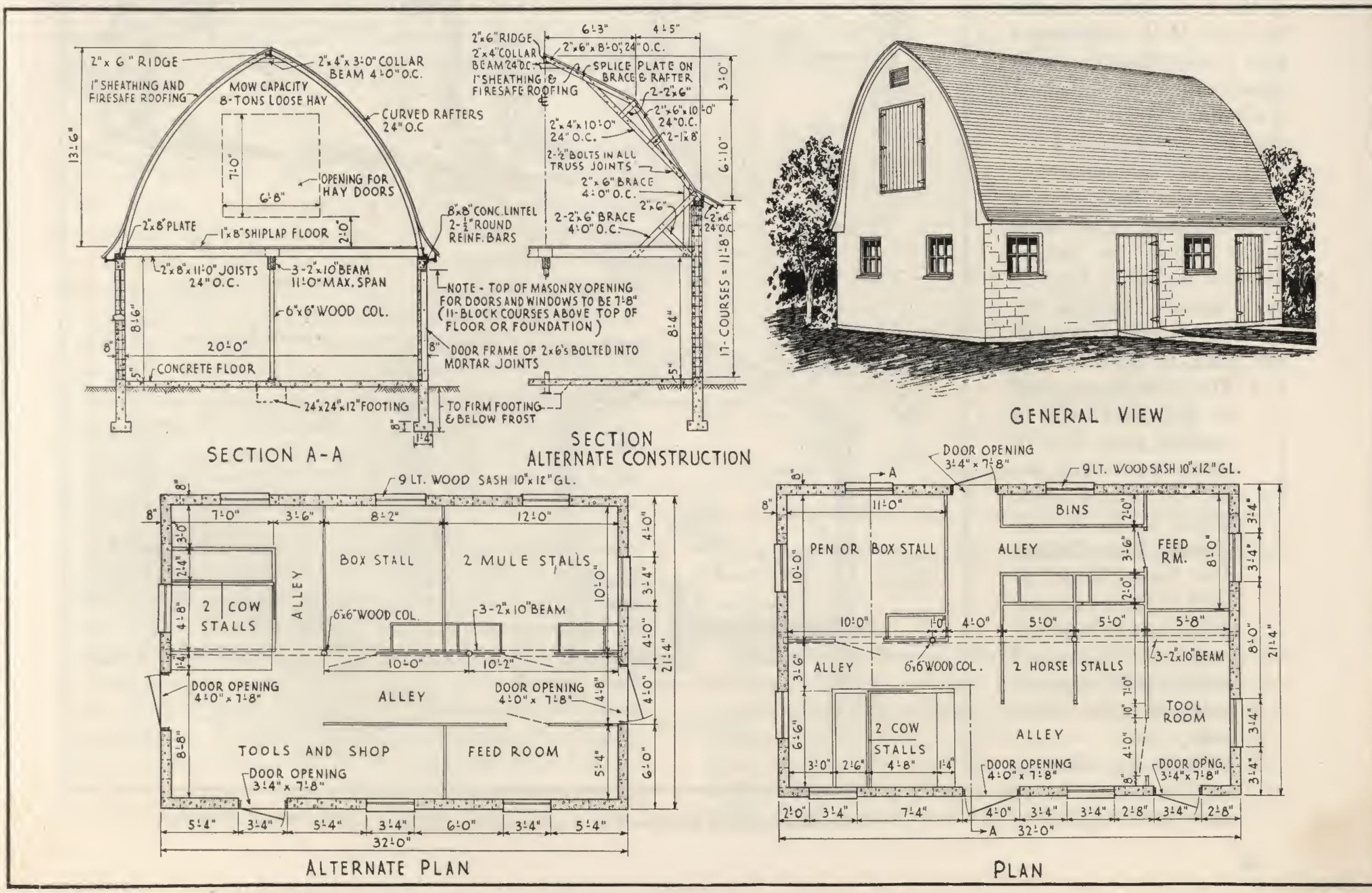
NOTE: INCREASE BARN LENGTH (IF DESIRED) BY 4 FT., 8 FT., 12 FT. ETC. TO MAINTAIN CONVENIENT SPACING OF DOORS AND WINDOWS.



FLOOR PLAN - "A"

General Purpose Barn. For details of construction ask for Plan C-2216.





General Purpose Barn. For details of construction ask for Plan C-2213.

Dairymen build a variety of concrete milk houses to meet individual preferences. The center house is completely firesafe, built with a precast joist concrete roof.

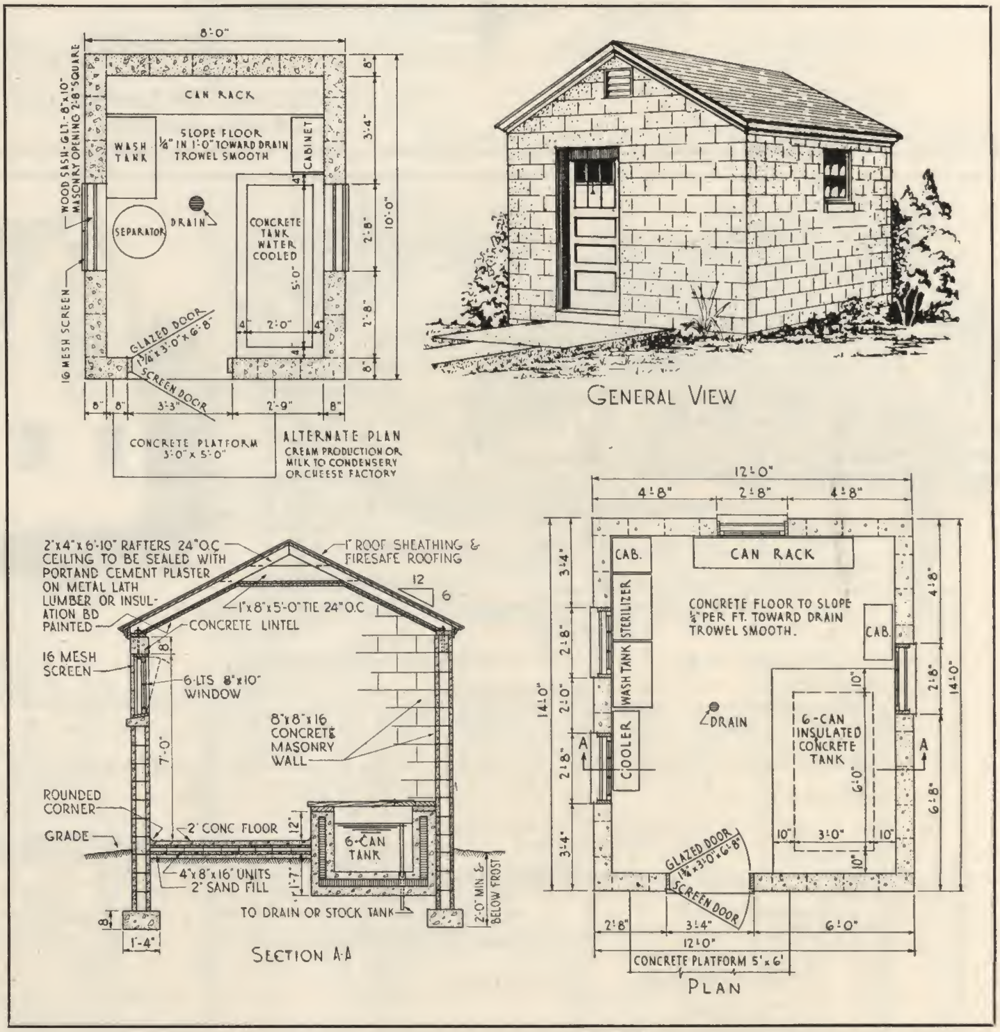
Sanitary Milk Houses and Insulated Cooling Tanks

Sanitary Milk Houses

To assure production of clean, high quality milk, local and state health departments usually require a separate milk house used only for the handling of milk and milk utensils. Milk house plans illustrated here meet requirements of modern milk ordinances, including those of the U. S. Public Health Service Milk Ordinance and Code. Before going ahead with construction, it is always advisable to have the plans approved by local health authorities.

Principal Milk House Requirements. The milk house should be located close to the dairy barn to save labor. Principal requirements found in modern milk ordinances are:

1. The milk house shall be provided with a smooth, tight floor of concrete or other impervious material sloped ¼ in. in 1 ft. toward floor drains. The floor should be built to form a rounded joint or cove at the junction of floors and walls to eliminate corners and angles which collect dirt.
2. Milk house walls and ceilings shall be of such construction as to permit easy cleaning. Walls of cast-in-place concrete, concrete block or tile and portland cement plaster are satisfactory when finished smooth.



One-Room Milk House. For construction details ask for Plan C-2154.

3. The milk house shall be properly lighted and ventilated. Satisfactory compliance with most ordinances is provided by window area of not less than 10 per cent of the floor area. One 25-watt electric light per 100 sq.ft. of floor area is also often required.

   Ventilation is obtained by installing windows of the tilt-in type together with either a small roof ventilator or ventilator louvers in the gable end wall.

4. The milk house shall be effectively screened. Windows, doors, ventilators and all other openings are covered with 16-mesh screening to prevent entrance of flies.

5. The milk house shall be used for no other purpose than handling of milk and milk utensils, and it shall not open directly into a stable or into any room used for human sleeping quarters or other domestic purpose.

6. The milk house shall be provided with facilities for heating water and cleaning milk utensils.

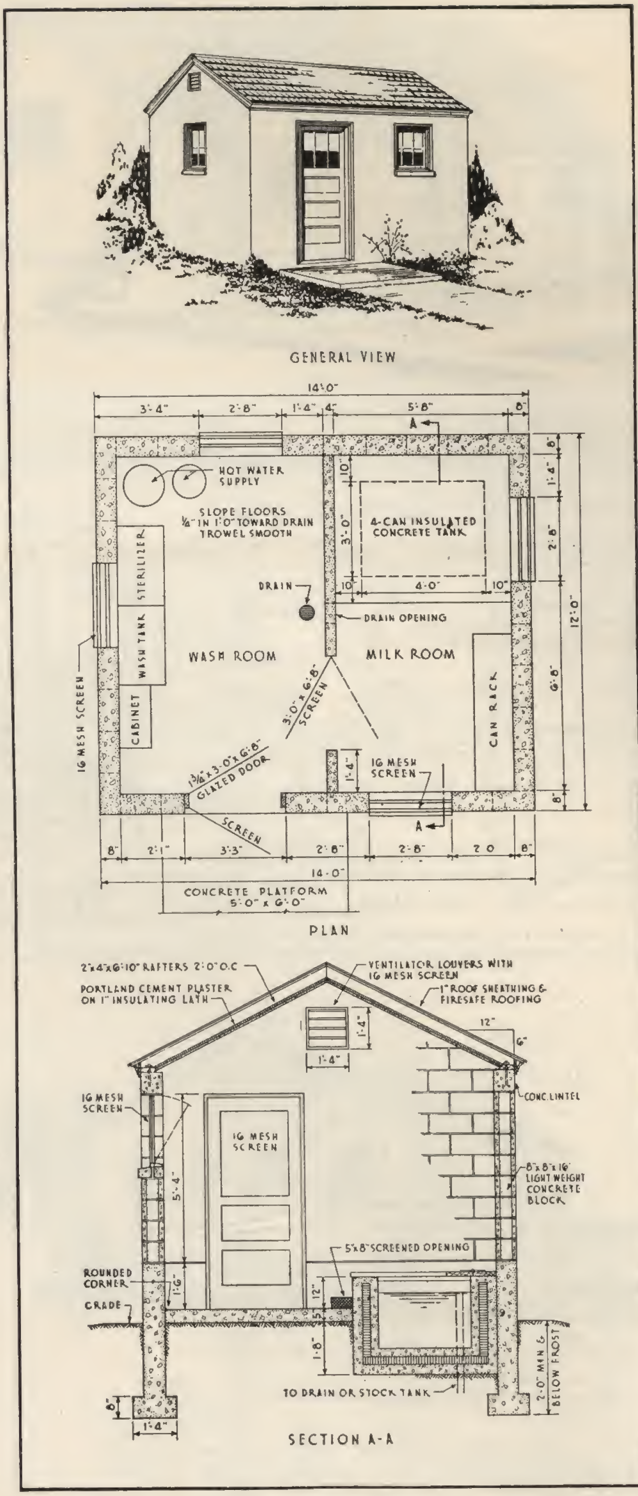
Table IX—Suggested Floor Space of Milk Houses —Raw Milk to Plant for Bottling*

Milk output, gal.	Existing milk houses, ft.	Future milk houses, ft.
Up to 20	10x 8	12x10
20 to 50	10x10	12x12
50 to 100	10x12	12x14
Over 100	10x14	12x16

*Suggested in U. S. Public Health Service Milk Ordinance and Code.

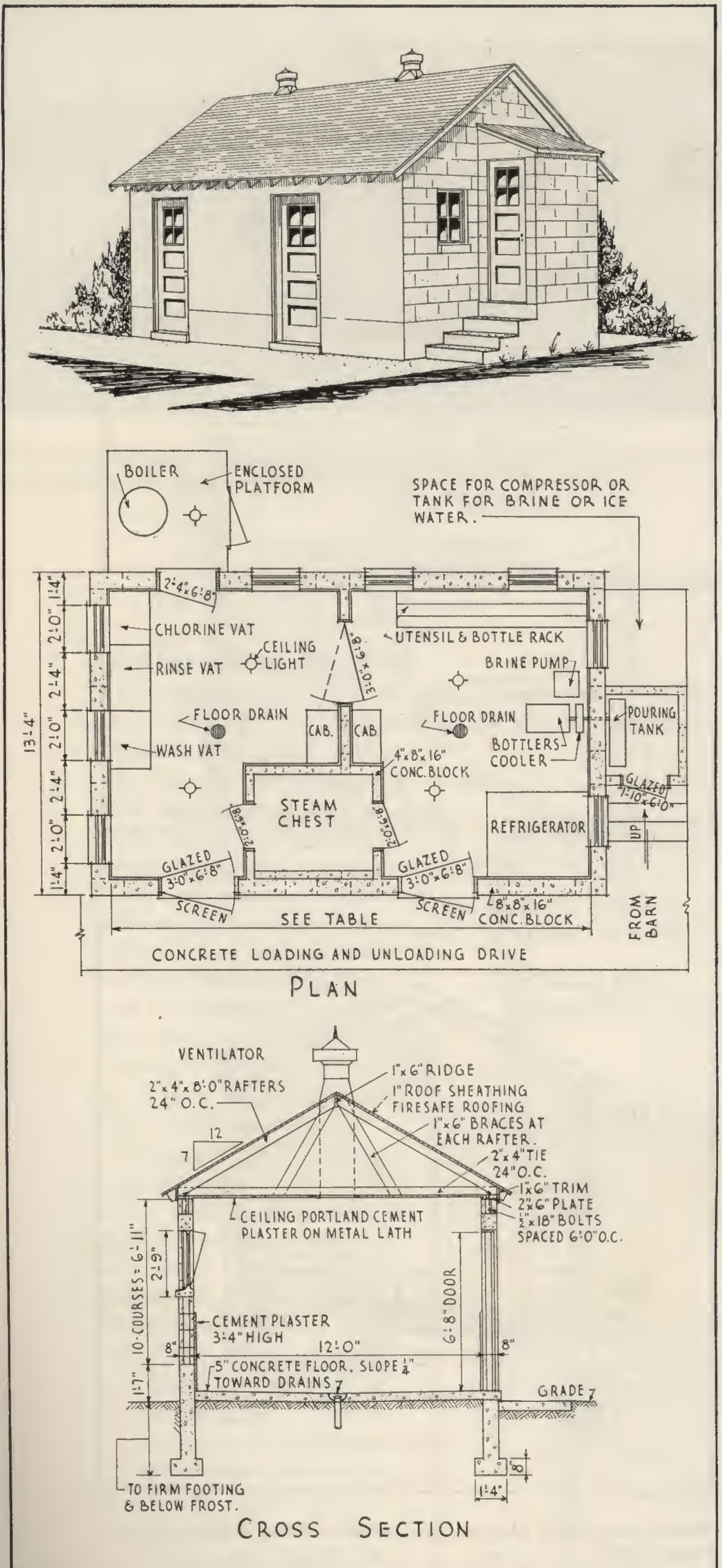
The 1-Room Milk House — Raw Milk to Plant for Bottling. One floor plan of the 12x14-ft. 1-room milk house shown in plan C-2140 is designed for dairies producing raw milk which is sent to a plant for bottling and retailing. The house meets code requirements for a daily output of from 50 to 100 gal. of milk. Tank may be increased to 8 or 10 ft. for 8 and 10 cans respectively. If 4-can size is sufficient, reduce the length of house and tank 2 ft. Sometimes local regulations require different dimensions of the milk house but the arrangement of doors, windows, equipment, etc., shown should usually be retained. Suggested floor space of milk houses in the U. S. Public Health Service Milk Ordinance and Code is given in Table IX.

1-Room Milk House — Raw Milk to Condensery, Cheese Factory or Creamery. Where milk is sent to condensery or cheese factory or separated for cream production, the milk house need not meet usual milk ordinance requirements, and is generally of somewhat smaller size. The "alternate plan" for a 1-room milk house 8x10 ft. shown in Plan C-2154 meets the usual requirements. If raw milk may in the future be sold to plants for bottling, however, it is advisable to build a 10x12-ft. or larger house and have the plans approved by the local milk inspector.



Two-Room Milk House. For construction details ask for Plan C-2141.

2-Room Milk House. The 2-room milk house shown in Plan C-2141 is required in some milk sheds for producers selling raw milk to plants bottling Grade A and Grade B milk. The 12x14-ft. house shown accommodates an insulated concrete cooling tank holding four 10-gal. cans. For dairies of larger capacity, the lengths of the cooling tank and milk room are increased 2 ft.



Small Retail Dairy. For construction details ask for Plan C-2142.

for each additional 2 cans of milk to be cooled.

The principal feature of this house is the complete separation of the storage of milk and clean milk utensils from the washing and bactericidal treatment of equipment. Features of this house are shown in the details.

Small Retail Dairy and Larger Milk Houses. Plan No. C-2142 shows a milk house plan for a 2-room retail dairy producing and bottling up to 50 gal. of milk per day. Outside dimensions are 13 ft. 4 in. by 20 ft. 8 in. Suggested floor space of milk houses for dairies which bottle milk on the premises is given in Table X. These dimensions are in accord with the U. S. Public Health Service Milk Ordinance and Code.

Plan C-2143 shows a **3-room milk house** which meets the needs of dairies producing and bottling up to 50 gal. of milk daily, and which provides boiler and fuel space in a room at one end of the building. Outside dimensions are 12 ft. 8 in. by 28 ft. 8 in. This milk house also meets the requirements of dairies producing over 100 gal. of milk daily where raw milk is sent to plants for bottling and retailing.

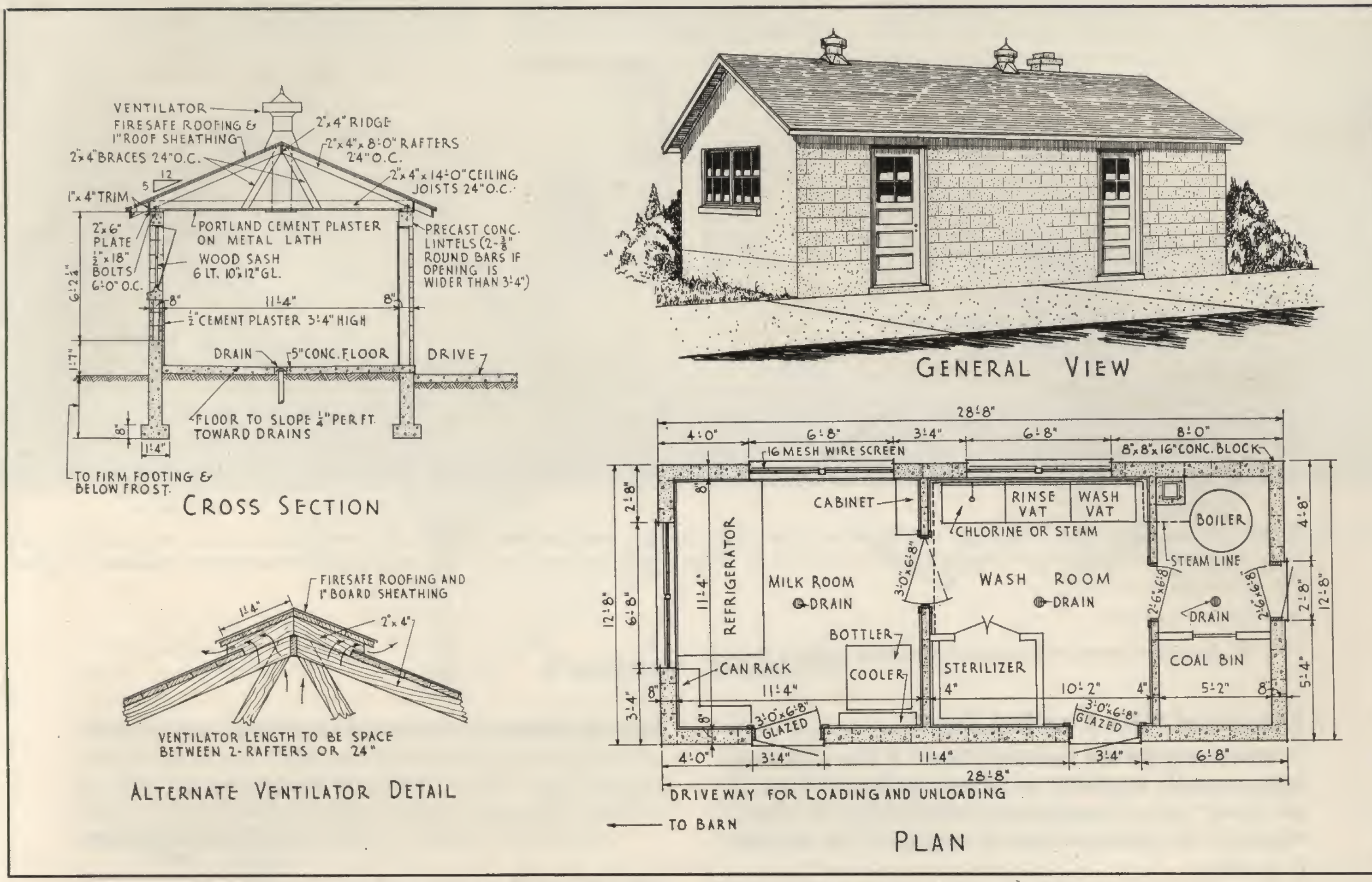
Pasteurizing Plant. Plans C-2144 for this plant meet the requirements of the Milk Ordinance and Code of the U. S. Public Health Service. The receiving room is separate from all other rooms. Milk is dumped into a vat and then piped into the pasteurizing equipment. The pasteurizing, processing, cooling and bottling operations are conducted as a group in a single room and a separate room is provided for washing and treatment of containers. A cooler is provided between the dump vat and pasteurizer to meet code requirements when milk is not pasteurized within 2 hours after receipt. The built-in refrigerator, locker room, boiler room and loading or unloading room in addition, make a very complete plant.

Table X—Suggested Floor Space of Milk Houses Where Milk Is Bottled by Producer*

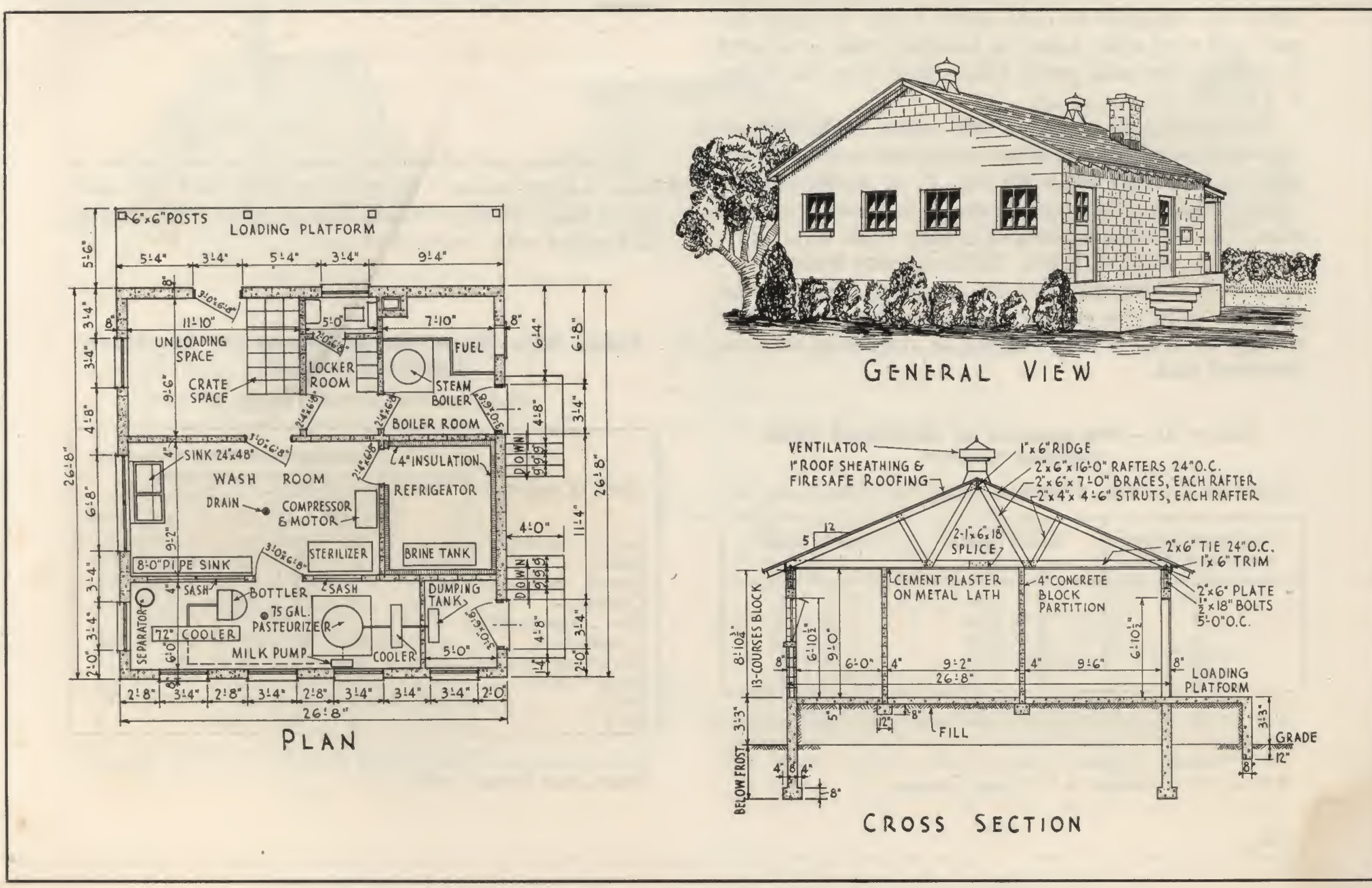
Milk output, gal.	Existing milk houses, ft.	Future milk houses, ft.
Up to 20	12x14	12x18
20 to 50	12x16	12x20
50 to 100	12x18	12x22
Over 100	12x20	12x24

*Suggested in U. S. Public Health Service Milk Ordinance and Code.

The insulated concrete cooling tank is economical to build and helps cool milk efficiently.



Three-Room Milk House. For construction details ask for Plan C-2143.



Pasteurizing Plant. For construction details ask for Plan C-2144.

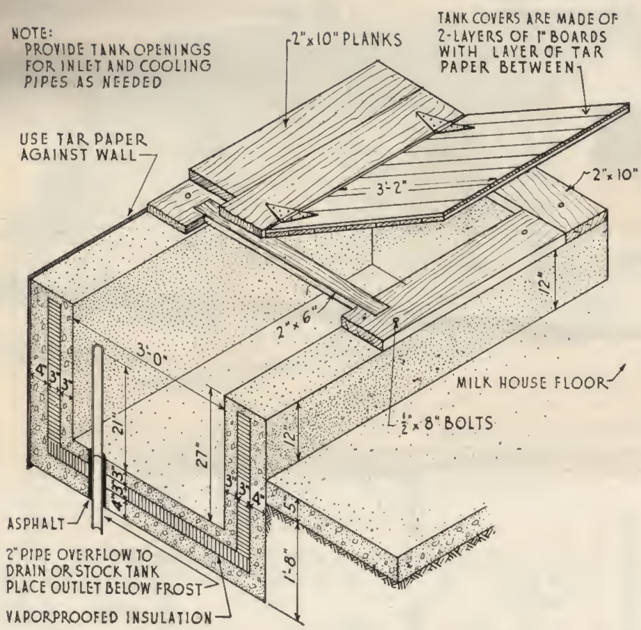


FIG. 17. Principal parts of insulated concrete cooling tank.

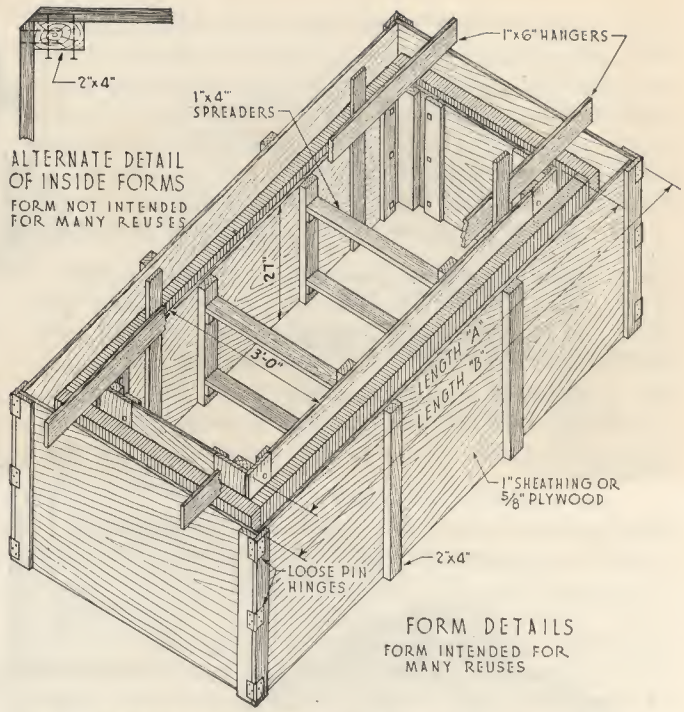


FIG. 18. Method of forming the insulated concrete tank.

Insulated Milk Cooling Tank

When to Build the Insulated Tank. Where milk regulations specify that milk be cooled rapidly to 50 deg. F. or lower, ice or mechanical refrigeration is usually required. An insulated tank is employed for economy in cooling.

Size of tank depends upon the number of cans of milk to be cooled. *See Table XI*. For efficient cooling, tanks are designed to hold about 3 gal. of water for each gallon of milk. Labor in handling cans is reduced by placing the tank partly below floor level, as shown in Fig. 17.

With a plentiful supply of cold water, **tanks without insulation** may be built where regulations do not require milk to be cooled below 60 deg. F. or where milk or cream is sold to condenseries, cheese factories or creameries. The uninsulated tank is usually built about 2 ft. wide, 27 in. deep with 4-in. thick concrete walls. However, if it is probable that an insulated tank may be required later, the cooling tank should be built large enough so that it may readily be converted into an insulated tank.

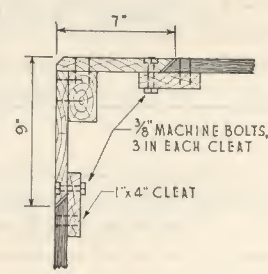


FIG. 19. Detail of corner of inside forms intended for many reuses.

In building an uninsulated tank, it is good practice to leave a space about 6 in. wide between tank and milk house wall. This space can then be filled with cinders and sealed with concrete at top.

Table XI—Dimensions of Insulated Milk Cooling Tanks*

Tanks are 36 in. wide, 27 in. deep inside—see Figs. 17 and 18.

Number of 10-gal. cans tank holds	Inside length *A*	Outside length *B*
4	4 ft. 0 in.	5 ft. 8 in.
6	6 ft. 0 in.	7 ft. 8 in.
8	8 ft. 0 in.	9 ft. 8 in.
10	10 ft. 0 in.	11 ft. 8 in.
12	12 ft. 0 in.	13 ft. 8 in.

*For details of insulated tank construction and additional information on milk houses request circulars *How to Build Sanitary Milk Houses*, *Insulated Cooling Tanks*, *Concrete Dairy Barn Floors*, free on request in U. S. and Canada.

Table XII—Materials Required for Insulated Concrete Tanks*

Built according to design in Fig. 17

Kind of material	Unit	Amount of materials needed for each size of tank				
		4-can	6-can	8-can	10-can	12-can
Sand	cu.yd.	.8	1.0	1.2	1.5	1.7
Gravel—¾-in.max.	cu.yd.	1.0	1.3	1.5	1.8	2.1
Cement	sacks	8	11	13	15	18
3-in. vaporproofed insulation	sq.ft.	74	92	110	128	146
Tar paper—cover	sq.ft.	18	24	30	36	42
1x6's—cover	lin.ft.	78	114	138	166	194
2x10's	lin.ft.	24	30	36	42	48
2x6's	lin.ft.	4	4	4	4	4

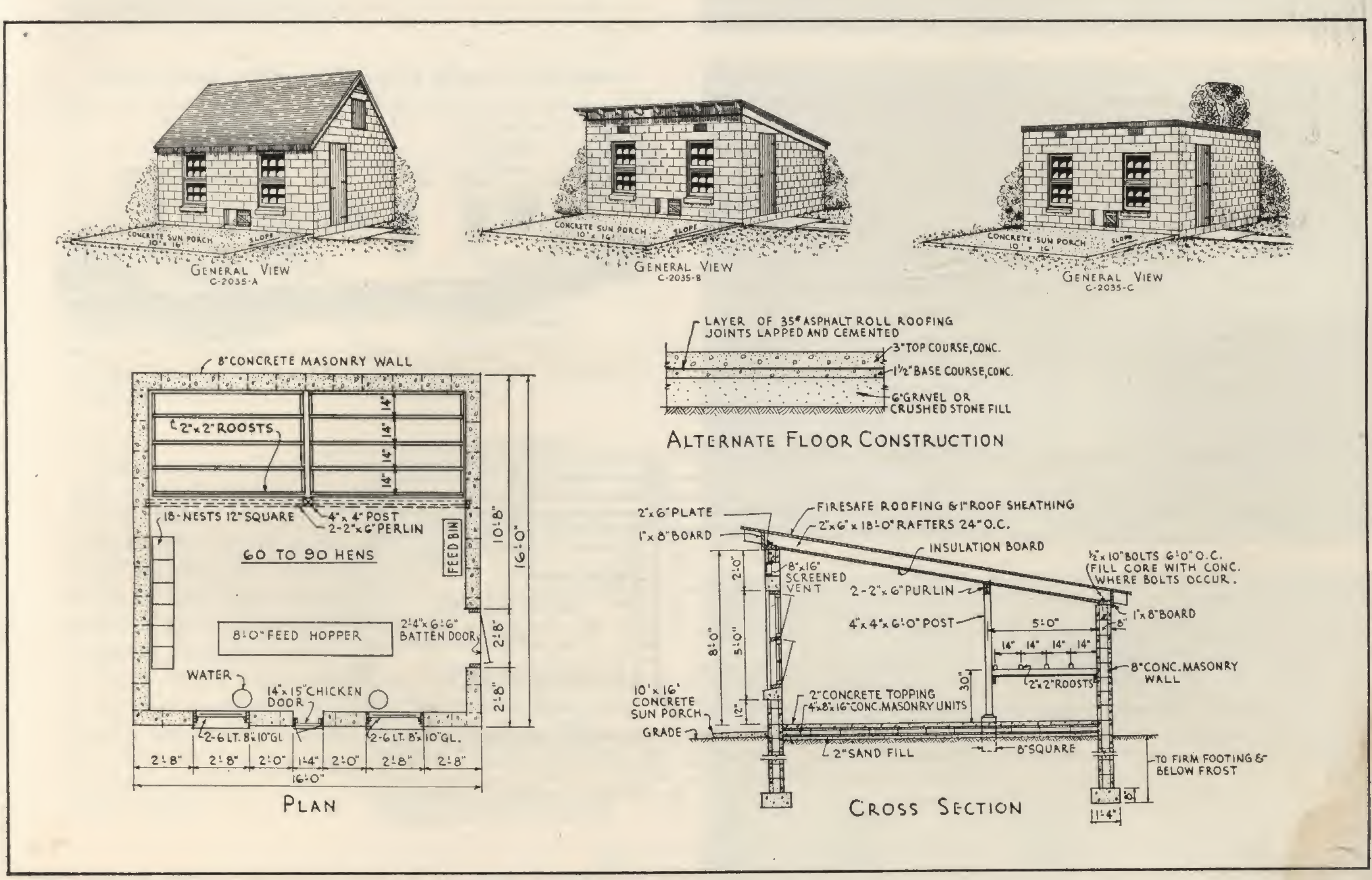
*Add miscellaneous material such as lumber for forms, tar paper, hinges, pipe fittings, nails, etc.

The well-insulated all-concrete poultry house provides ideal conditions for the flock and has the added advantages of firesafety and virtually no upkeep expense. For complete plans and construction details of this type laying house, see Plan No. C-2036.

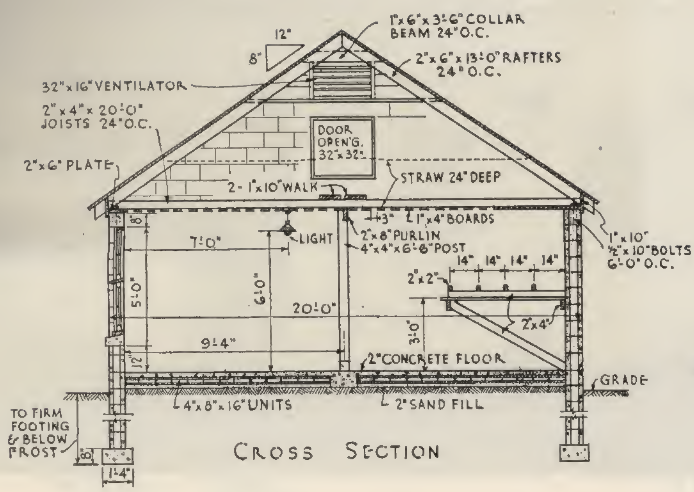
Poultry Houses

Successful poultrymen agree that a good laying house is more important than any other single factor in obtaining high egg production in winter months. And because winter eggs command higher prices, the poultryman is rapidly repaid for providing a comfortable house.

To keep the flock vigorous, healthy and active throughout the winter months the house must be warm, dry, well-lighted and properly ventilated. Thousands of successful poultrymen have built with concrete as the most practical means of meeting these requirements.

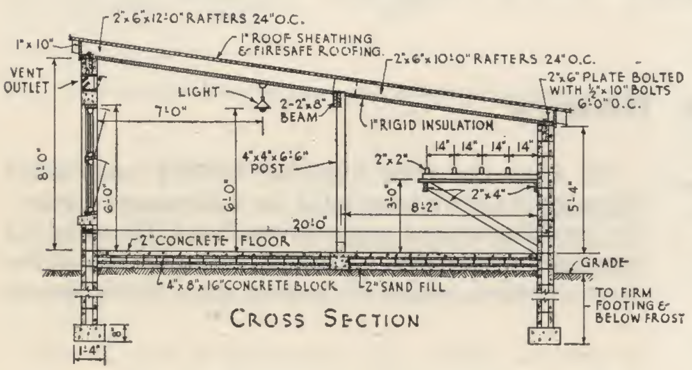


Poultry Brooder or Laying House. For construction details ask for Plan C-2035 A, B or C.



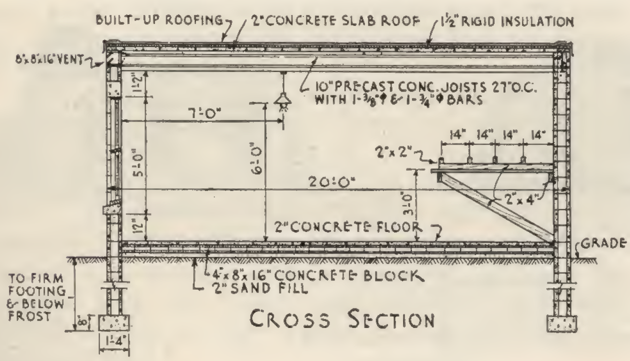
CROSS SECTION

GENERAL VIEW
C-2036-A



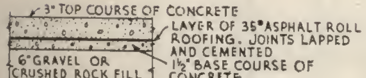
CROSS SECTION

GENERAL VIEW
C-2036-B

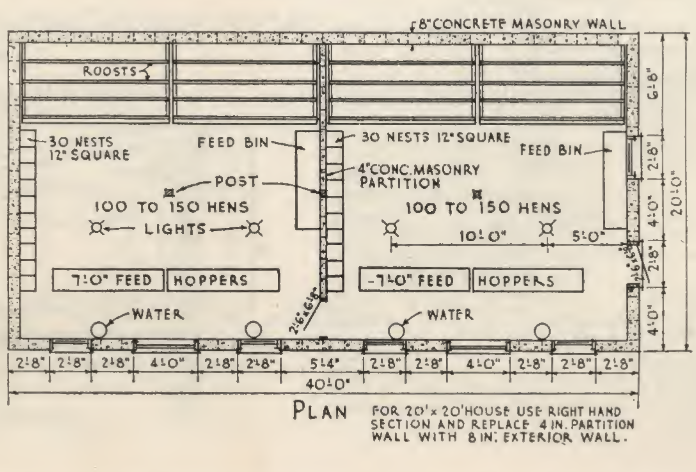


CROSS SECTION

GENERAL VIEW
C-2036-C



ALTERNATE FLOOR CONSTRUCTION



PLAN — FOR 20'x20' HOUSE USE RIGHT HAND SECTION AND REPLACE 4 IN. PARTITION WALL WITH 8 IN. EXTERIOR WALL.

Concrete Masonry Poultry House. Ask for Plan C-2036 A, B or C.

The modern concrete house makes it easy to maintain desirable, even temperatures either in winter or summer, thus helping to maintain high egg production throughout the year.

Other advantages of the concrete poultry house are: Smooth concrete surfaces are easily cleaned and kept clean and provide no crevices to harbor lice, mites or other poultry parasites; rats, weasels and other animals are kept out. Because concrete lasts indefinitely, a well-built concrete poultry house costs practically nothing for repairs and upkeep. Moreover, a concrete house is economical to build and is highly firesafe.

Planning the Poultry House

The plans in this booklet are designed to meet the requirements of modern poultry housing and to be in agreement with the more popular houses recommended by leading agricultural colleges and other poultry authorities. Careful planning makes these houses efficient, yet economical and of simple construction. It will pay the poultryman to study these designs carefully before building a new house.

Size of poultry house required depends mostly upon size of flock to be housed. In figuring floor area needed it is common practice to allow approximately 2½ to 3½ sq.ft. of floor per bird. About 3 to 3½ sq.ft. per bird may be required for heavy general purpose breeds, whereas leghorns ordinarily require about 2½ to 3 sq.ft. per bird. Floor space per bird should, however, be increased somewhat for small flocks and for flocks which are confined at all times.

Table XIII—Size of Poultry House to Build*

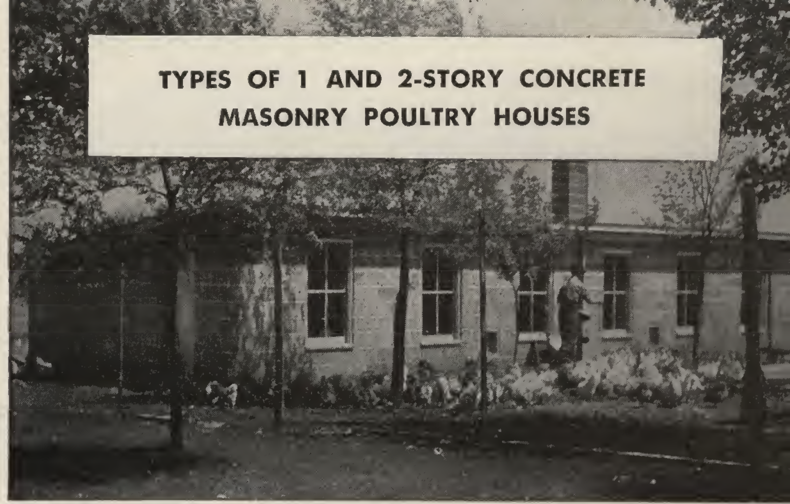
Number of mature birds in flock	Dimensions of house, ft.
60-90	16x16
100-150	20x20
200-300	20x40
300-475	20x70
900-1,200	32x48 two-story
1,500-2,000	32x96 two-story

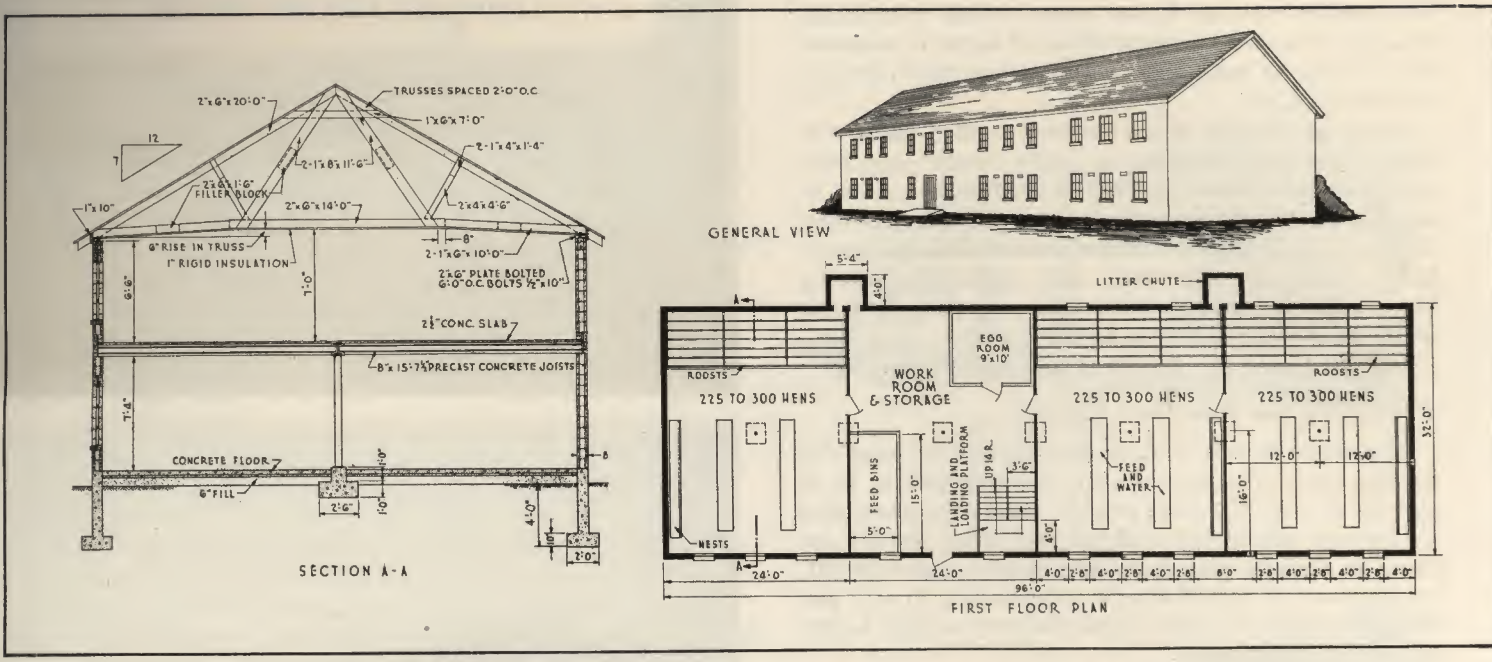
*House sizes are based on the generally accepted standard of approximately 2½ to 3½ sq.ft. of floor per bird.

Common sizes of laying houses are shown in Table XIII. A house 16 ft. square accommodates **60 to 90 hens.** *See Plan C-2035.* Length of house may be extended to accommodate up to about 180 birds, but it is usually more satisfactory and economical to build a wider house if more than 100 hens are kept. The 16-ft. wide house is also well-adapted to use as a permanent and stationary brooder house.

For flocks of **100 to 600 hens** the 20-ft. wide house is usually most satisfactory. *See Plan C-2036.* Each 20-ft. square pen accommodates 100 to 150 hens. Where 3, 4 or more 20-ft. sections are required, it is best to include a combination feed room and work room near the center of the house.

TYPES OF 1 AND 2-STORY CONCRETE MASONRY POULTRY HOUSES





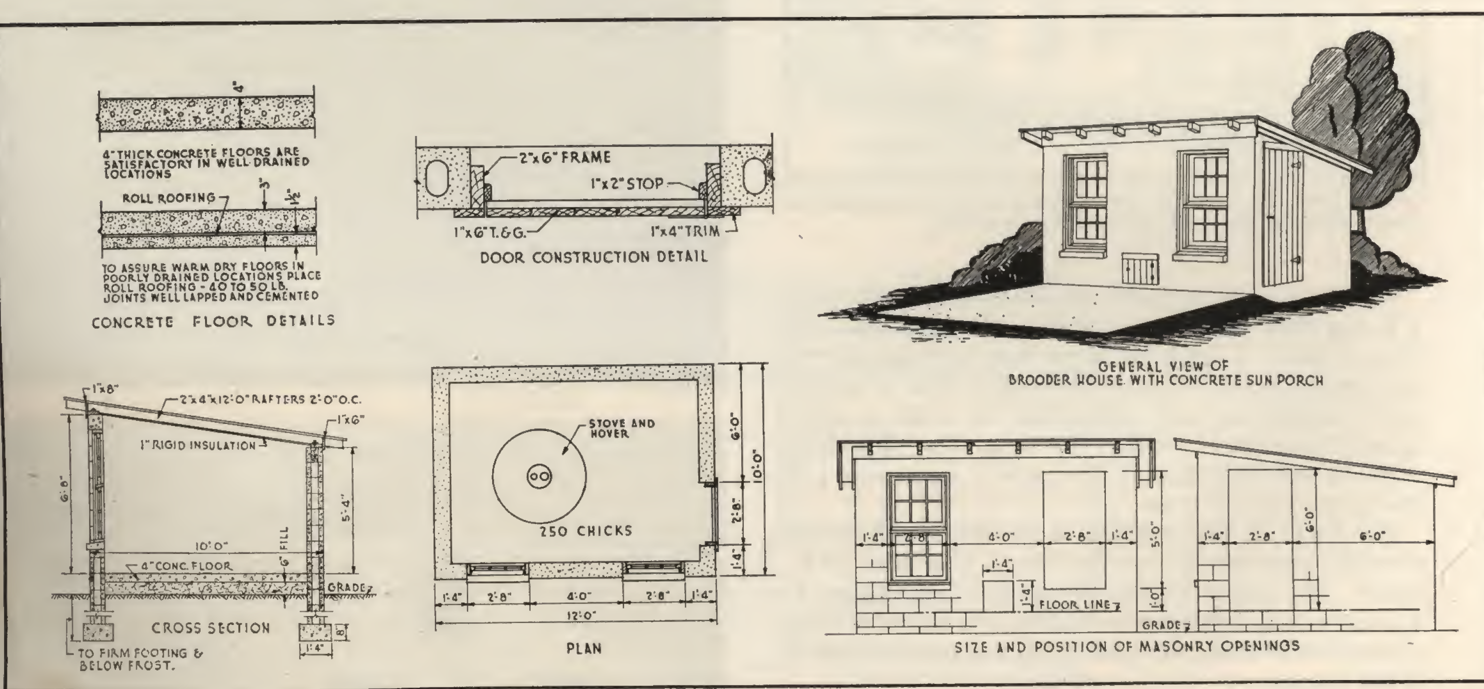
Two-Story Poultry House. For construction details ask for Plan C-2037.

Poultrymen keeping **more than 1,000 hens** often prefer the 2-story laying house. *See Plan C-2037.* Firesafe concrete construction is advantageous where a large flock and valuable equipment and feed are housed in a single structure.

Width of house should be a minimum of 16 ft. for very small flocks; 20 ft. for larger flocks. In the northern half of the United States, narrow houses tend to be too cold in winter and are more difficult to ventilate properly.

Height of poultry house ceiling in the northern states should also be low since usually the only source of heat in the house is the body heat of the poultry. For convenient operation, however, it is common practice to allow full headroom for the operator in all parts of the house, particularly where the house is well-insulated.

Location of house is usually near the family dwelling to permit convenient care of the flock. The poultry house should be located on high, well-drained ground to



Brooder House. For construction details ask for Plan C-2038.

provide most healthful conditions for the flock. Best practice is to face the house south for maximum sunlight.

Lighting is also an important consideration. Practical window sizes are shown in the plans for each size of house. Sometimes it may be desirable to substitute muslin-covered frames for a part of the window opening. Windows shown open in such a way as to admit direct sunlight and an abundance of fresh air when desired. To provide light under the roosts, 2-light or 3-light cellar sash are often installed in rear walls of the house. In northernmost states, however, these windows should be omitted to help make a warmer house. Window openings in warm climates are often merely screened with ½-in. mesh poultry netting.

A straw-loft house is popular with many poultrymen.

Shape of Roof

The shed roof is most economical to build and is, perhaps, most popular with poultrymen. However, the gable roof with a straw loft is also widely used. Advantages claimed for the straw loft are that it protects the poultry from extremes of temperature and from drafts, and helps keep the house warm and dry in winter. The modern flat roof is becoming popular for well-insulated firesafe concrete construction.

Miscellaneous

Electric wiring should be installed where possible to permit use of **artificial light. Nests** are usually built 12 to 14 in. square and 1 nest is required for about 5 hens. **Roosts** are usually built of 2x2 or 2x3-in. material, spaced about 14 in. apart and set on 2x4-in. supports as shown in the plans. **Feed hoppers** of modern type are usually built well up off the floor, and from 15 in. to 2 ft. wide. About 10 to 12 ft. of hopper length is required for each 100 birds. Running water should also be installed when available.

Heating and Air Conditioning

In the Small Poultry House. Since proper housing is such an important factor in high egg production, modern poultry houses are built to conserve heat in winter and maintain more nearly uniform temperatures as well as to supply an abundance of fresh air without drafts. These conditions are secured by building well-insulated walls and roofs, and by installing a ventilating system. Insulation is important in the small poultry house since the only heat ordinarily available is that supplied by the body heat of the poultry. Then, too, well-insulated walls and roof are essential to the satisfactory operation of the ventilating system. Where stove heat is supplied during cold weather, the concrete house is especially advantageous because of its firesafety.

In addition to supplying fresh air without objectionable drafts, a good ventilating system also removes foul, moist air in winter, thus helping to insure a warm, dry house.

In the Large Poultry House. Poultrymen who keep several thousand hens often install a complete heating system in the laying house to maintain temperatures of about 50 deg. F. during cold weather. Some large operators have gone further, installing a complete air conditioning system to help step up egg production.

For economical heating and for satisfactory operation of the ventilating system, it is important to provide well-insulated walls and roof as explained above for the small poultry house.

Concrete Brooder Houses and Sun Porches

A stationary concrete brooder house and sanitary sun porch, as shown in Plan C-2038, provide a maximum of comfort for chicks. The chicks can be confined to a thoroughly clean and disinfected sun porch of smooth concrete. The concrete sun porch should slope about 6 in. for 10 or 12 ft. of width for convenient cleaning and flushing of the surface.

A brooder house 10x12 ft., accommodates about 250 chicks. A larger house, as shown in Plan C-2035, may be built to have a capacity of 500 to 1,000 or more chicks and this house may readily be converted to a laying house later if desired. Experience shows that firesafe concrete construction is particularly advantageous in the brooder house as a safeguard against the fire hazard created by the brooder stove.

For additional information on poultry housing, request Portland Cement Association booklet *Improved Poultry Housing with Concrete**.

*Furnished free in U. S. and Canada.

Concrete and stone construction makes use of native materials.

This modern hog house is not only adequately lighted and well ventilated, but because it is of concrete construction it has virtually no repair expense and is easy to keep clean. Note the concrete porch and walks.

Hog Houses

Modern methods of pork production favor the central farrowing house. The principal advantages of the central house are convenience, efficiency and sanitation. More pigs are saved in the well-managed central house than with other systems because the central house provides dry, warm quarters and can be kept free from parasites.

The confinement method of raising hogs on concrete from birth until ready for market is a great advancement in the production of pork. Although strict sanitation is necessary for the success of this method, concrete farrowing houses and feeding floors make it very easy to meet the high degree of sanitation necessary*.

Early farrowing is possible with a well-insulated central house. Four types of well-insulated concrete walls are shown on page 16.

The flat roof construction shown is favored by some because it provides full headroom in all parts of the house. It is easily ventilated and has no large amount of waste space.

Planning the Hog House

Size and Shape of House. The size of house required depends upon the number of sows kept and upon pen size and width of alley desired. Where only 4 or 5 sows or less are kept, the single row house shown in Plan C-2170 is economical and convenient. Many livestock farmers require larger accommodations and build the double row farrowing house. *See Plan C-2169.*

Location. For convenience and efficiency the hog house should be located near feed supplies and faced south if outside pens and feeding floor are provided only on one side of the house. Where outside pens are desired on two sides, one side of the house is made to face east, the other west. The house should be placed so that prevailing winds carry odors away from the farmstead.

Pen Size. Pens 6 ft. wide by 8 ft. long are commonly used where small sows are kept. For medium size to large sows, pens about 7x8 ft. are more satisfactory.

Large litters of healthy little pigs are easier to obtain in a well-built central house where careful attention can be given to sanitation.

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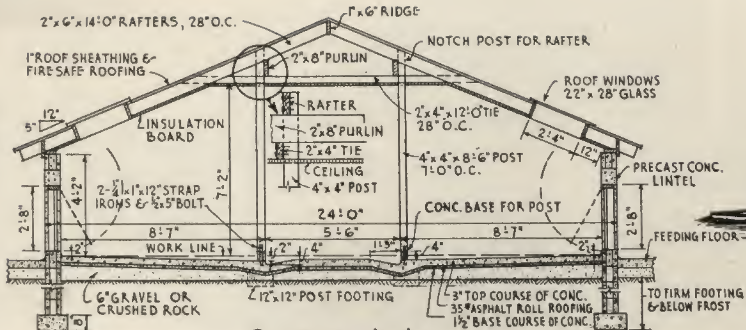
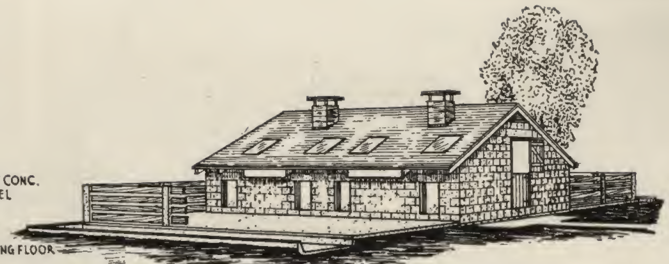
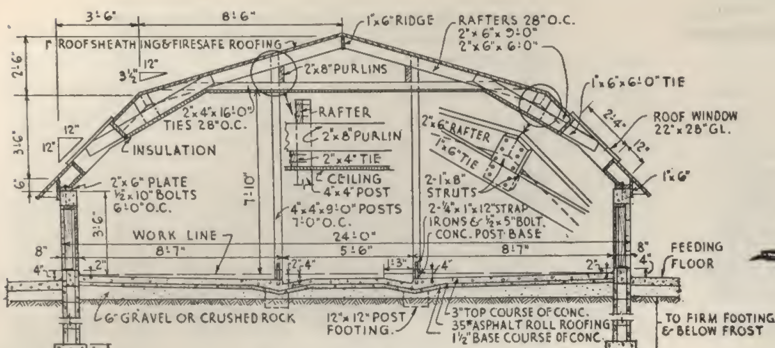
*Information on the confinement method will be furnished free in U. S. and Canada on request to Portland Cement Association.



SECTION A-A


GENERAL VIEW
C-2169 A



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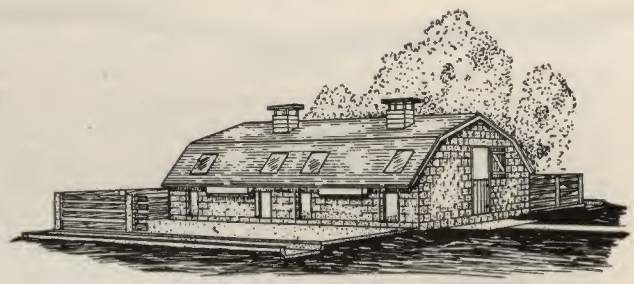
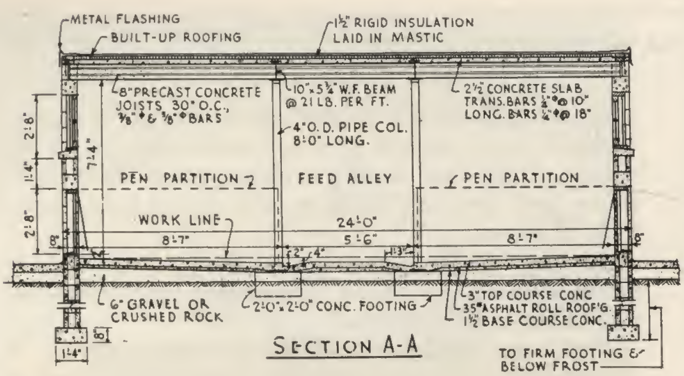
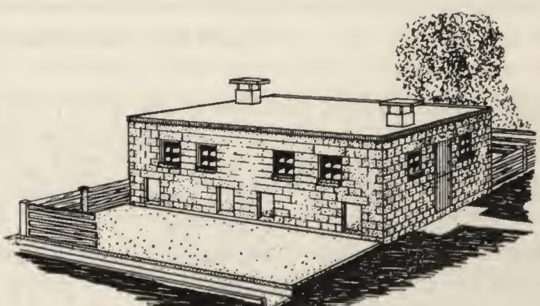
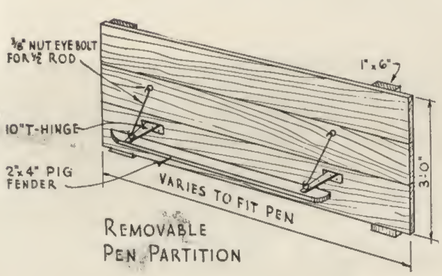

GENERAL VIEW
C-2169-B

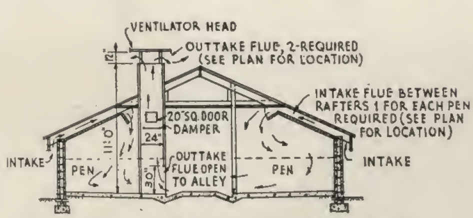


SECTION A-A

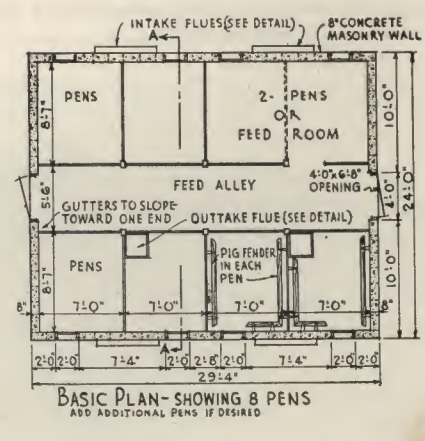

GENERAL VIEW
C-2169-C



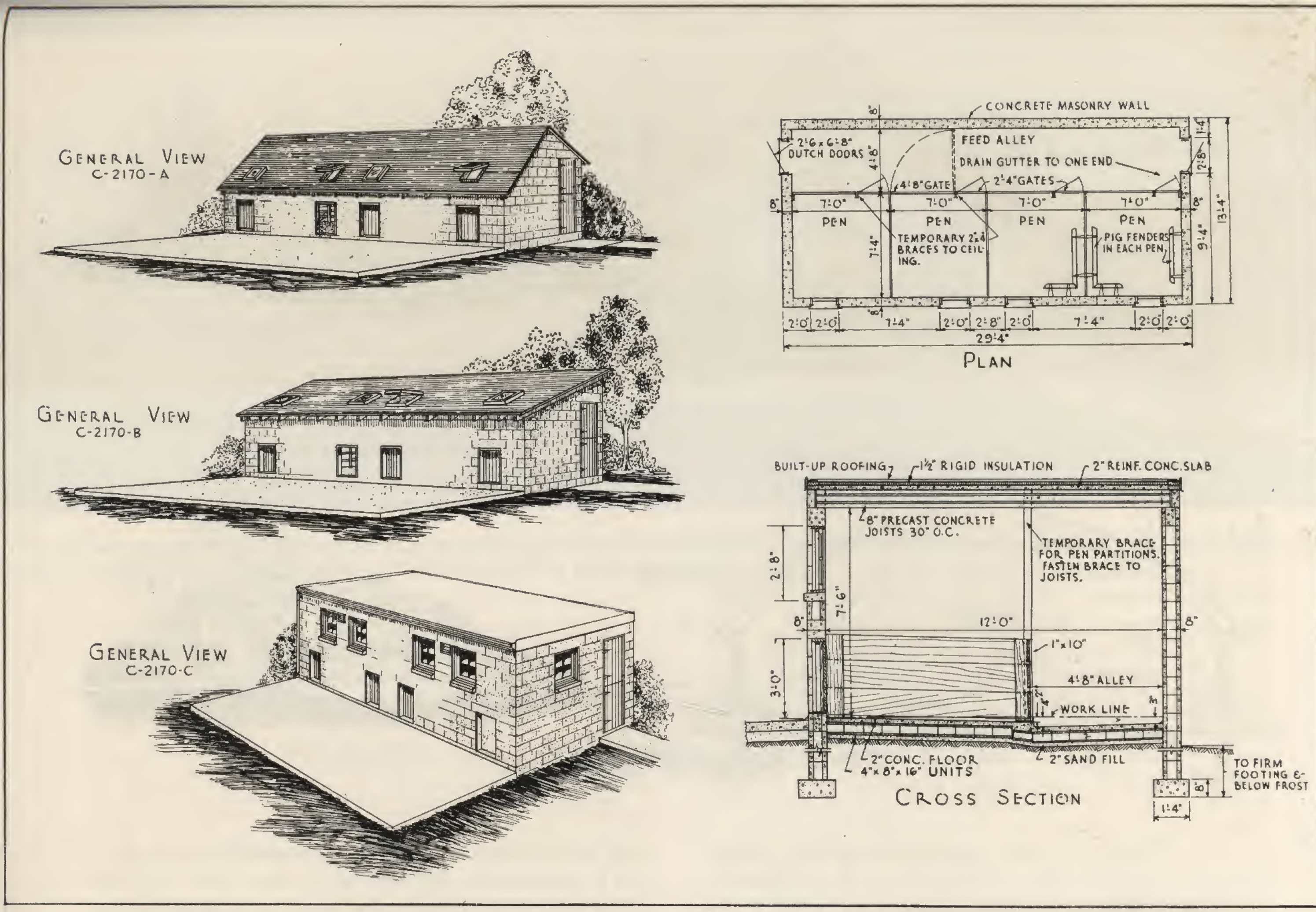
REMOVABLE
PEN PARTITION



TYPICAL DETAIL OF NATURAL DRAFT VENTILATION



BASIC PLAN- SHOWING 8 PENS
ADD ADDITIONAL PENS IF DESIRED



Single Row Farrowing House. Ask for Plan C-2170 A, B or C.

Light. It is common practice to use 4 to 7 sq.ft. of glass area per sow. In the northern half of the United States where it is important to conserve heat at early spring farrowings, it is best to have not more than 4 sq.ft. of window glass area per sow.

Heat and Ventilation. Cold, damp houses at farrowing time are responsible for heavy losses of young pigs from pneumonia and colds. For best results the foul, moist air must be removed by ventilation. Heat is often supplied for a few weeks at farrowing time. Pigs seem to do best with temperatures around 65 deg. F. A small stove located in the central alley or in the corner of the feed room provides needed extra heat. Stove heat does not endanger the central house when built of concrete.

Modern ventilating equipment makes it possible to secure effective, low-cost ventilation providing the building is well-insulated.

Fresh air intakes, whether for natural draft or mechanical ventilating systems, should be located as

A central hog house is a big convenience and saves labor at farrowing time. Concrete masonry walls assure warm, dry, comfortable quarters for early spring litters.

Good examples of the modern gable roof and gambrel roof hog houses. Houses like these in the northern half of the United States should have insulated ceilings about 7 ft. 6 in. above the floor to provide a warm house for early spring farrowings.

shown in Plan C-2169. Manufactured intakes prevent back-draft. With natural draft ventilation, 1 outtake flue, 24 in. square inside, located as shown, is required for each 4 sows. This arrangement provides about 144 sq.in. of flue area per sow, which is somewhat greater than required to meet average conditions. The sliding damper is convenient in adjusting the flue area. The 20-in. square door near the roof is opened to remove warm air in summer. With mechanical ventilation the average hog house has only 1 or 2 outtakes directly through the side wall, usually equipped with electric fans controlled by thermostats.

Feed Room Requirements. To reduce labor costs, a feed room is often built in the farrowing house as shown in the plans. Self-feeders of large capacity may also be built into the side of the feed room, providing access by the hogs from the paved lot as shown in the layout of the Confinement System, Fig. 20. Those specializing in low-cost pork production make the hogs practically feed themselves by using the self-feeder and and automatic waterer.

Miscellaneous. There are several other important considerations in planning the central farrowing house: **Width of central alley** may vary from 4 to 8 ft. Many find a width of about 5 ft. most convenient. Where it is planned to drive through the central alley, a width of 8 ft. is required. **Ceiling height** of 7 to 8 ft. is generally considered most desirable. Higher ceilings make cold houses in the northern half of the United States. In the South, higher ceilings are desirable, however, to help maintain a cooler house during hot weather. **Doors and Gates.** Main doors from outside to the central alley should be a minimum of 2 ft. 8 in. wide by 6 ft. 8 in. high. Gates from pen to feed alley should be 2 ft. 4 in. to 2 ft. 8 in. wide by about 3 ft. 0 in. high. Partitions are commonly about 3 ft. high. **Hog doors** from pens to outside paved lots or runways are customarily 2 ft. wide by 2 ft. 8 in. high. Where very large sows are kept, however, these doors should be built 3 ft. 4 in. high. **Troughs** of cast-in-place concrete are desirable since they cannot be moved or overturned and eliminate the nuisance of leaky troughs requiring

John H. Hendriks, Muscatine County, Iowa, finds it especially profitable to confine his pigs on concrete the entire time from farrowing until ready for market.

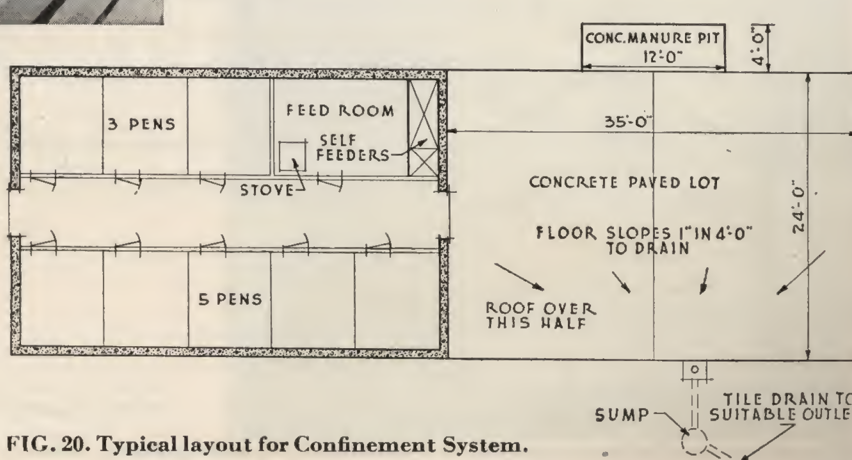


FIG. 20. Typical layout for Confinement System.

frequent repairs. **Guard rails** or fenders protect little pigs from being crushed by the sow. Standard dimensions and method of construction are shown in the plans. For further details on hog houses and equipment, ask for booklet *Modern Hog Farm Improvements**.

The Single Row Farrowing House

The single row house Plan C-2170 is economical and convenient where not more than 4 or 5 sows are kept. Maximum warmth and sunlight for early farrowings are provided by having the house face south. The plan shows construction details for a firesafe, all-concrete house.

*Free in U. S. and Canada on request to Portland Cement Association.

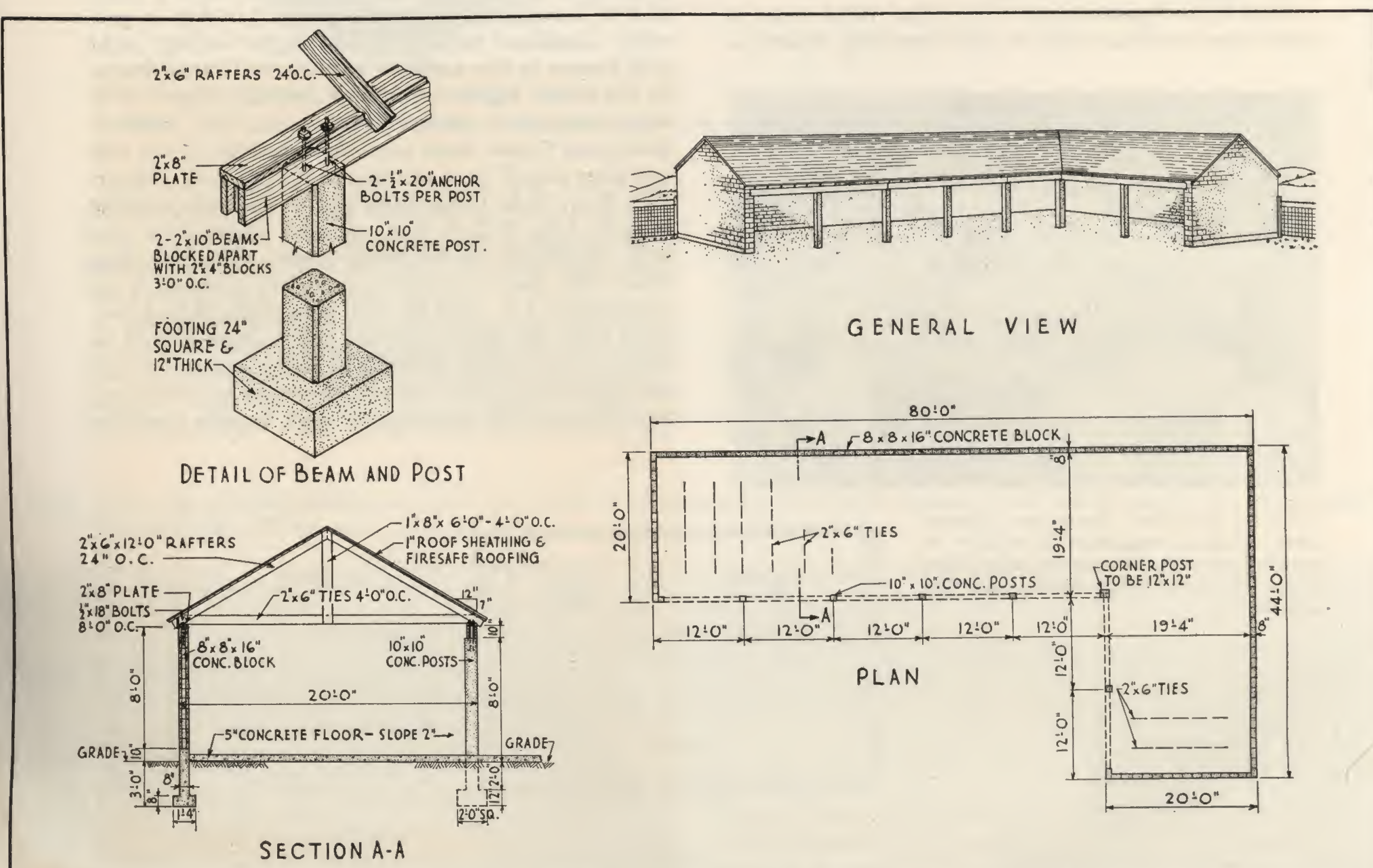
The Double Row Farrowing House

Where 6 to 12 sows or more are kept the double row farrowing house Plan C-2169 is standard construction. This house is usually located with the long way north-south so that pens on the east side receive the morning sun, those on the west the afternoon sun. Sometimes the house is placed east-west with outside pens only on the south side. In the Confinement System the long way runs north-south with the paved lot at the south end of the house making a sunny, sheltered place for young pigs.

To keep the house warm in winter and cool in summer, well-insulated construction is shown for both roof and walls. Interior pen partitions facing the feed alley are of concrete masonry with a convenient opening through the wall to the concrete trough.

Cattle Shed

The concrete masonry cattle shed illustrated by Plan C-1367 is ideal for sheltering stock from the sun in summer and storms in winter. By using movable racks and bunks it may be used as a feeding shed. The concrete floor makes excellent footing for the cattle and is a big help in cleaning. A shed 100 ft. long accommodates 100 steers where they are unconfined or 50 steers if confined to the shed.



Cattle Shed. Ask for Plan C-1367.

Concrete Grain Storages for the Farm

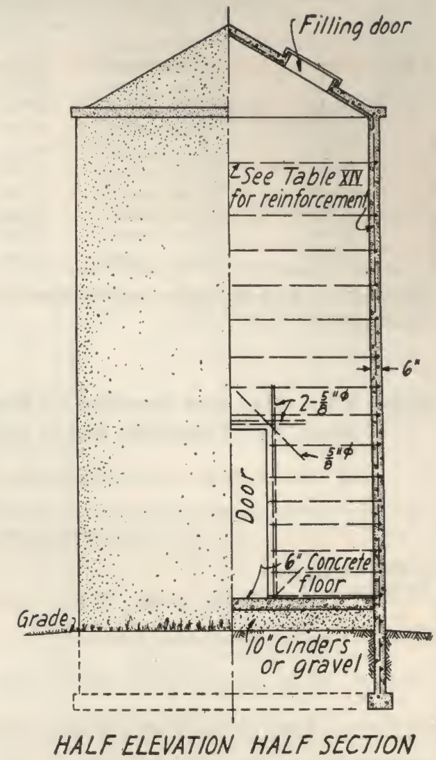
Concrete grain bins provide ideal storage conditions: they are dry, ratproof and safe against fire. Windstorms, destructive to less substantial storages, do not damage concrete structures. The natural advantages of concrete in grain storage construction are recognized in the fact that practically every large grain elevator in the country is built of concrete.

Concrete grain storage structures may have circular or square bins, either as individual units or in batteries of several bins to accommodate different kinds and grades of grain. The combination corncrib and granary of concrete is also popular in many states.

Circular Bins

Circular grain bins may be built of either solid, cast-in-place concrete or of concrete staves. The circular type of storage is usually the more economical to build. Table XIV shows the horizontal reinforcement required for solid cast-in-place concrete bins. Vertical reinforcement consists of ⅜-in. round bars placed 12 in. center to center. The reinforcement is placed in the center of the wall. Additional reinforcement is required around doorways or other large openings, consisting of two ⅝-in. round bars parallel to the sides, top and bottom of the opening and ⅝-in. hooked bars placed diagonally

FIG. 22. Individual grain bins of circular concrete construction are often built near the feed lot to provide most efficient storage of feed grains. Bins may be built of solid cast-in-place concrete or concrete staves.



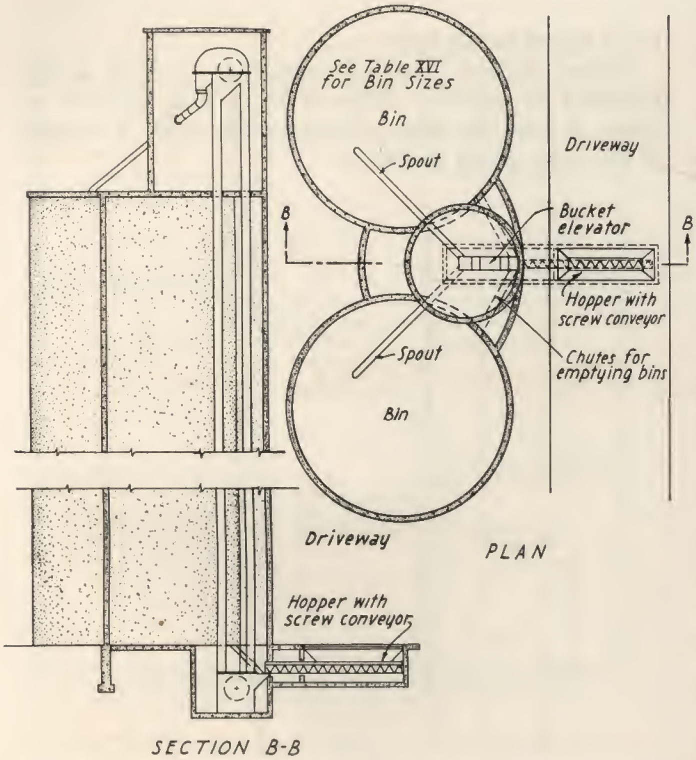


FIG. 21. Where storage requirements are moderately large, two or more bins are usually constructed. A built-in elevator is used to load and unload the grain.

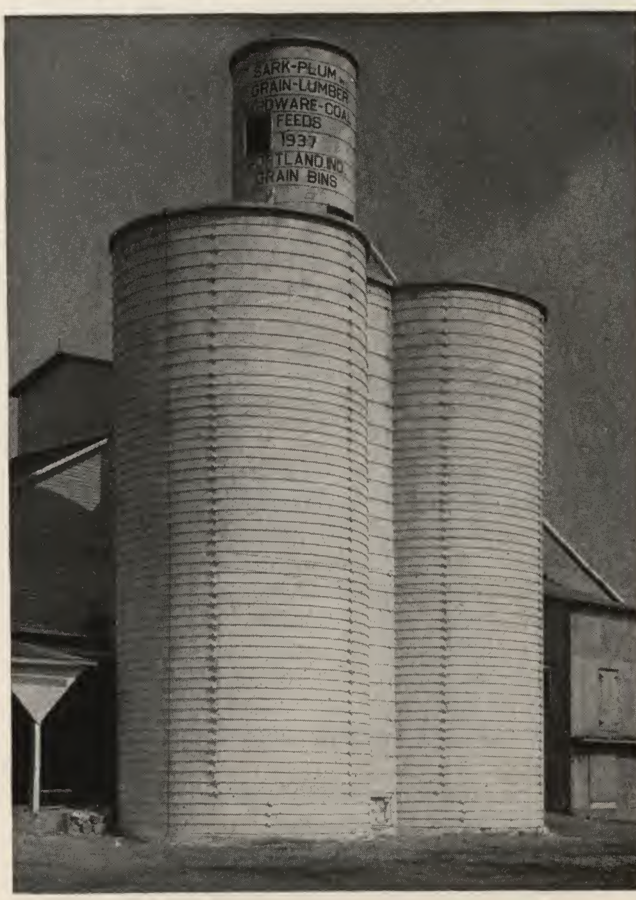


Table XIV—Horizontal Reinforcement for Circular Grain Bins*

Distance from top of bin, ft.	Diameter of bin: 12 ft. Size	12 ft. Spacing on centers	16 ft. Size	16 ft. Spacing on centers	20 ft. Size	20 ft. Spacing on centers	24 ft. Size	24 ft. Spacing on centers
0-5	3/8 in. round	24 in.	3/8 in. round	24 in.	3/8 in. round	22 in.	3/8 in. round	18 in.
5-10	3/8 in. round	24 in.	3/8 in. round	16 in.	3/8 in. round	12 in.	3/8 in. round	10 in.
10-15	3/8 in. round	18 in.	3/8 in. round	12 in.	3/8 in. round	9 in.	3/8 in. round	7 in.
15-20	3/8 in. round	16 in.	3/8 in. round	10 in.	3/8 in. round	7 in.	3/8 in. round	6 in.
20-25	3/8 in. round	14 in.	3/8 in. round	9 in.	3/8 in. round	6 in.	3/8 in. round	5 in.
25-30	3/8 in. round	12 in.	3/8 in. round	8 in.	3/8 in. round	6 in.	1/2 in. round	8 in.
30-35	3/8 in. round	12 in.	3/8 in. round	8 in.	3/8 in. round	5 in.	1/2 in. round	7 in.
35-40	3/8 in. round	12 in.	3/8 in. round	7 in.	1/2 in. round	9 in.	1/2 in. round	7 in.
40-45	3/8 in. round	12 in.	3/8 in. round	7 in.	1/2 in. round	9 in.	1/2 in. round	6 in.
45-50	3/8 in. round	12 in.	3/8 in. round	7 in.	1/2 in. round	8 in.	1/2 in. round	6 in.

*Walls are to be 6 in. thick. Vertical reinforcement is 3/8-in. round bars, 12 in. on centers. All reinforcement bars are round and placed in the center of the wall.

Table XV—Size and Spacing of Hoop Reinforcing Rods for Concrete Stave Grain Bins

All rods are 9/16-in. round unless shown otherwise.

Distance from top	Diameter of bin: 10, 12 and 14 ft.	16 ft.	18 ft.	20 ft.	25 ft.	30 ft.
0-10 ft.	15 in.	15 in.	15 in.	15 in.	15 in. (5/8-in. round rods)	15 in. (11/16-in. round rods)
10-15 ft.	15 in.	15 in.	15 in.	15 in.	15 in.	10 in.
15-20 ft.	15 in.	15 in.	10 in.	10 in.	10 in.	10 in.
20-25 ft.	15 in.	15 in.	10 in.	10 in.	10 in.	10 in.
25-30 ft.	15 in.	10 in.	10 in.	10 in.	10 in. (11/16-in. round rods)	10 in. (3/4-in. round rods)
30-35 ft.	15 in.	10 in.	10 in.	7½ in.	10 in.	7½ in.
35-40 ft.	15 in.	10 in.	10 in.	7½ in.	7½ in.	7½ in.
40-45 ft.	15 in.	10 in.	10 in.	7½ in.	7½ in.	7½ in.
45-50 ft.	15 in.	10 in.	10 in.	7½ in.	7½ in.	7½ in.

at the corners. *See Fig. 23.* Walls are 6 in. thick for all bin sizes shown in Table XIV. Capacities of various sizes of circular grain bins in bushels are shown in Table XVI.

Concrete stave bins are reinforced by steel hoops. The size and spacing of the hoops are governed by the diameter and height of the bin; the grain pressures being greater in larger bins, more hoops are required. Table XV shows reinforcement needed.

Well-built, solid, cast-in-place concrete walls are impervious to moisture. It is common practice to apply a portland cement wash to the outside surfaces of grain bins made of concrete staves. This coating fills the joints and seals the surface against moisture penetration.

There are several common types of circular grain bins. Fig. 22 shows an individual bin. This is a simple type of storage and can be filled by a small portable elevator or by hand shoveling if the amount of grain

Table XVI—Capacity of Circular Bins, Bu.*

Depth of bin, ft.	Diameter of bin: 12 ft.	16 ft.	20 ft.	24 ft.
10	900	1,610	2,510	3,620
15	1,360	2,410	3,770	5,430
20	1,810	3,220	5,020	7,230
25	2,260	4,020	6,280	9,040
30	2,710	4,820	7,530	10,850
35	3,160	5,620	8,780	12,650
40	3,620	6,430	10,050	14,470
45	4,070	7,230	11,290	16,260
50	4,520	8,040	12,560	18,090

*Capacities computed to the nearest 10 bu., assuming 1.25 cu.ft. per bu.

to be stored is not large.

Where several bins are required to store larger amounts of grain or different kinds and qualities of grain, it may be more economical to build a storage of the type shown in Fig. 21.

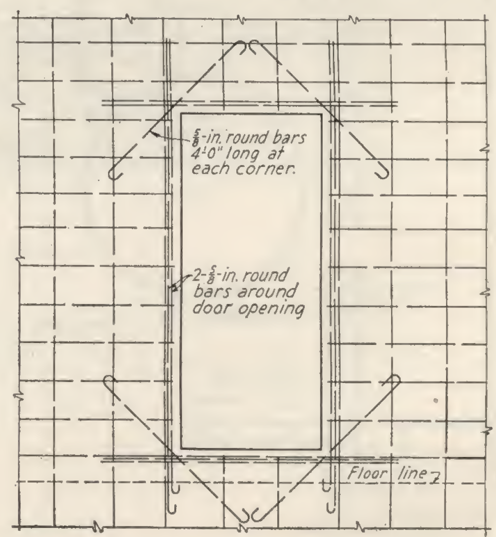


FIG. 23. Additional reinforcing bars are required around doorways and other openings to strengthen the structure and minimize danger of cracking.

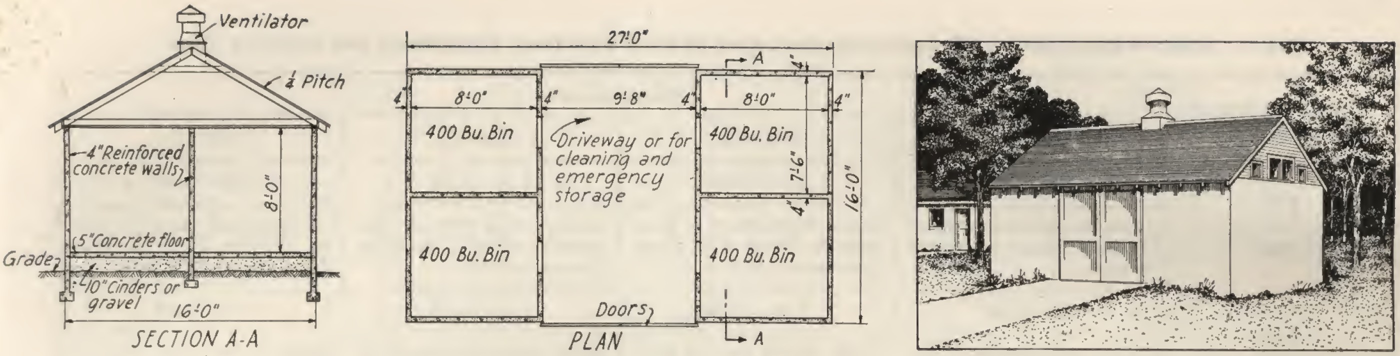


FIG. 24. To provide safe and efficient storage on many livestock and dairy farms, smaller granaries of square bins may be most practical. Bin sizes for various storage requirements are shown in Table XVIII.

Square Bins

Square concrete grain bins are often built for the smaller grain storages and where circular forms are not readily available. For bins of large capacity, however, it is usually more economical to construct circular bins.

The horizontal steel reinforcement required for square bins is shown in Table XVII. This table also shows the thickness of wall required for bins of different sizes and indicates just how far the reinforcement should be placed from the outside face of the wall. Vertical reinforcement consists of $\frac{3}{8}$-in. round rods placed 12 in. center to center and to which the horizontal rods are wired. The manner of placing the horizontal reinforcing bars is indicated in Fig. 25. It will be noted that, where

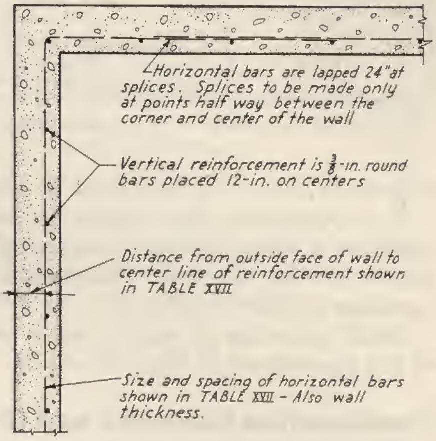


FIG. 25. Reinforcing bars for square bins should be carefully placed as indicated here and in Table XVII.

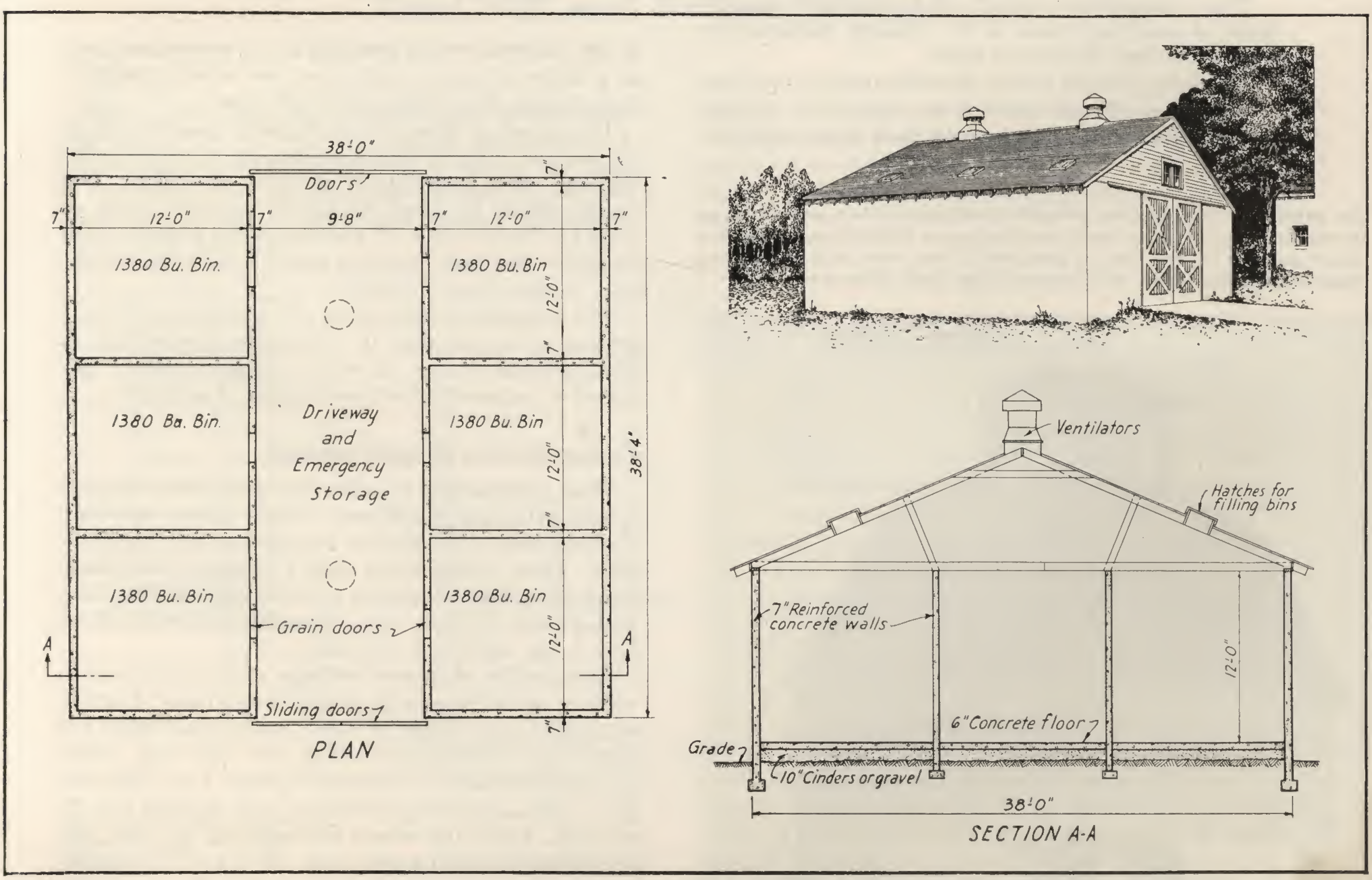


FIG. 26. Larger grain and livestock farms may require storages of this type. Where large quantities of grain must be stored, it is often more practical and economical to build circular concrete bins.

Table XVII—Horizontal Reinforcement and Wall Thickness Required for Square Bins*

Distance from top of bin	Dimensions			
	8x8 ft.	10x10 ft.	12x12 ft.	14x14 ft.
5 ft. or less	4 in. thick	4 in. thick	5 in. thick	6 in. thick
	½-in. round bars at 8-in. centers. Place in center of wall.	½-in. round bars at 6-in. centers. Place 2 in. from the outside face.	⅝-in. round bars at 9-in. centers. Place 3 in. from the outside face.	⅝-in. round bars at 7½-in. centers. Place 3½ in. from the outside face.
5 ft. to 10 ft.	6 in. thick	6 in. thick	7 in. thick	8 in. thick
	½-in. round bars at 12-in. centers. Place 4 in. from the outside face.	½-in. round bars at 8-in. centers. Place 4 in. from the outside face.	⅝-in. round bars at 9-in. centers. Place 4½ in. from the outside face.	⅝-in. round bars at 7-in. centers. Place 5 in. from the outside face.
10 ft. to 15 ft.	6 in. thick	6 in. thick	7 in. thick	8 in. thick
	½-in. round bars at 10-in. centers. Place 4 in. from the outside face.	½-in. round bars at 6-in. centers. Place 4 in. from the outside face.	⅝-in. round bars at 7-in. centers. Place 4½ in. from the outside face.	⅝-in. round bars at 5-in. centers. Place 5 in. from the outside face.

*Vertical reinforcement is ⅜-in. round bars spaced 12 in. center to center. Distances from face of wall are to centerline of bars.

splices are made, the bars must be lapped 24 in.

It is important that splices in horizontal bars be made at a point halfway between the corner and the center of the bin wall. Reinforcement around door openings is shown in Fig. 23.

Small granaries of square bin construction may be of the type shown in Figs. 24 and 26.

Combination Corncrib and Granary

The combination corncrib and granary is usually built of concrete staves in the manner indicated by Plan C-749 and the picture below.

Ventilation for ear corn is provided through openings in the staves. These openings are screened to exclude rats and mice by the use of steel rods or mesh embedded in the concrete, or the openings in the staves are made as a series of narrow slots that are small enough to keep rodents from passing through them.

The trench or dragway in the floor enables corn to be dropped directly into the drag or conveyor when shelling, with a minimum of hand shoveling. This trench should be large enough to provide plenty of room for the conveyor. The bottom of the trench should be above the grade line and sloped toward the outside wall to insure good drainage.

The design and construction of concrete stave storage structures are handled by companies specializing in that business. Names of such companies will be furnished on request to Portland Cement Association.

An attractive combination corncrib and granary is a popular type of construction in many grain-growing areas. Firesafe and weatherproof storage for ear corn is provided in the crib sections having ventilated stave walls. Solid staves form tight bins overhead.

Table XVIII—Capacity of Square Bins, Bu.*

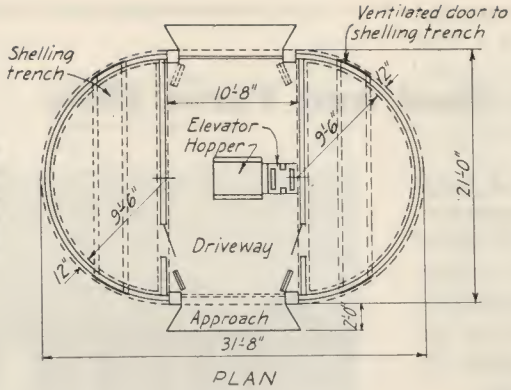
Depth of bin, ft.	Dimensions			
	8x8 ft.	10x10 ft.	12x12 ft.	14x14 ft.
5	260	400	580	780
10	510	800	1,150	1,570
15	770	1,200	1,730	2,350

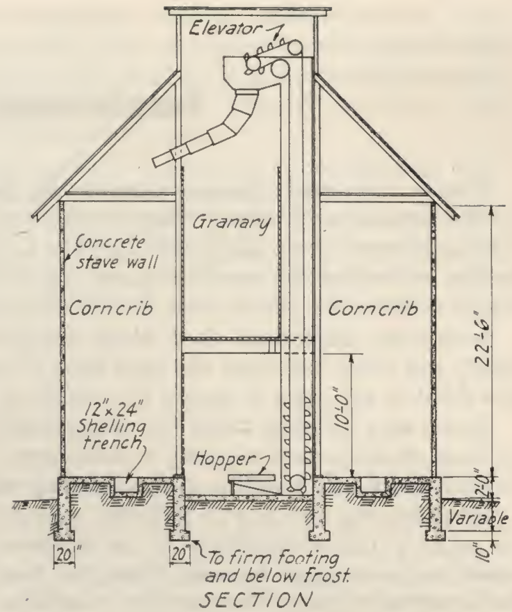
*Capacities computed to nearest 10 bu., assuming 1.25 cu.ft. per bu.

Construction Requirements

Floor construction in cribs and grain bins deserves special attention. Experience shows that a *well-built* concrete floor provides the best protection for stored grain. These simple rules, rigidly followed, will assure a well-built floor: Place the grain storage building on a well-drained location, and follow recommendations on page 8 for building a dry floor.

Construction of proper footings under foundation walls of grain bins is of utmost importance. Uneven settlement and failure of many storage buildings are caused by inadequate footings. On firm soil, small buildings will need a footing slab about 9 in. thick and 16 in. wide under the foundation wall. Storage bins 20 to 50 ft. high, and where footings rest on firm soil, should have a footing slab 12 in. thick and 24 in. wide.





Typical plan and section of a combination corncrib and granary as pictured at the bottom of opposite page. Ask for Plan C-749.

For bins more than 50 ft. high, or if a very soft clay, loam or quicksand is found at the footing level, it will be necessary to build wider footings or place the footings on piles. Concrete mix for footings is given in Table I, page 4.

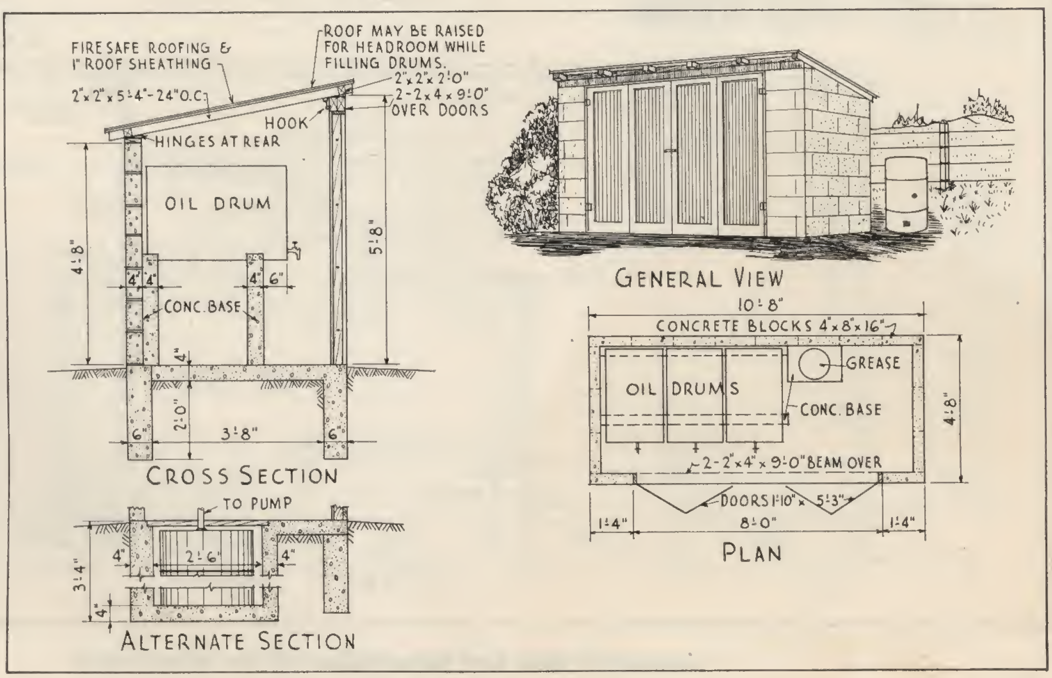
Ventilation is an important consideration in all grain storage structures. Common practice is to place a ventilator at the top of the storage so that all bins may be ventilated at the top.

For further information send for booklet *Concrete Grain Storages for the Farm*, free in the U. S. and Canada on request to Portland Cement Association.

Fuel, Oil and Grease Storage

Keeping fuel, oil and containers clean helps assure long and trouble-free service from the farm tractor. A fuel storage as shown in Plan B-2221 will not only help in this respect but can be locked against thieves and reduces the fire hazard around the garage or implement shed where fuel barrels are usually stored. Any size building can be made to meet individual requirements. The standard 55-gal. drum measures 3x2 ft. The inside width of the building would have to be at least 4 ft. while the length would vary according to the number of barrels. Four feet of additional length should be provided at one end for grease and other storage.

For barrels of larger capacity the dimensions of the building must be increased accordingly. A pit may be built as shown in the alternate plan when a pump is used.



Fuel, Oil and Grease Storage. Ask for Plan B-2221.

Implement Shed and Farm Shop

Shelter and timely repairs increase the life of farm machinery and avoid costly delays during rush seasons. The implement shed illustrated in Plan C-2174 gives ample protection for machinery and provides a shop where repair work can be done in any kind of weather.

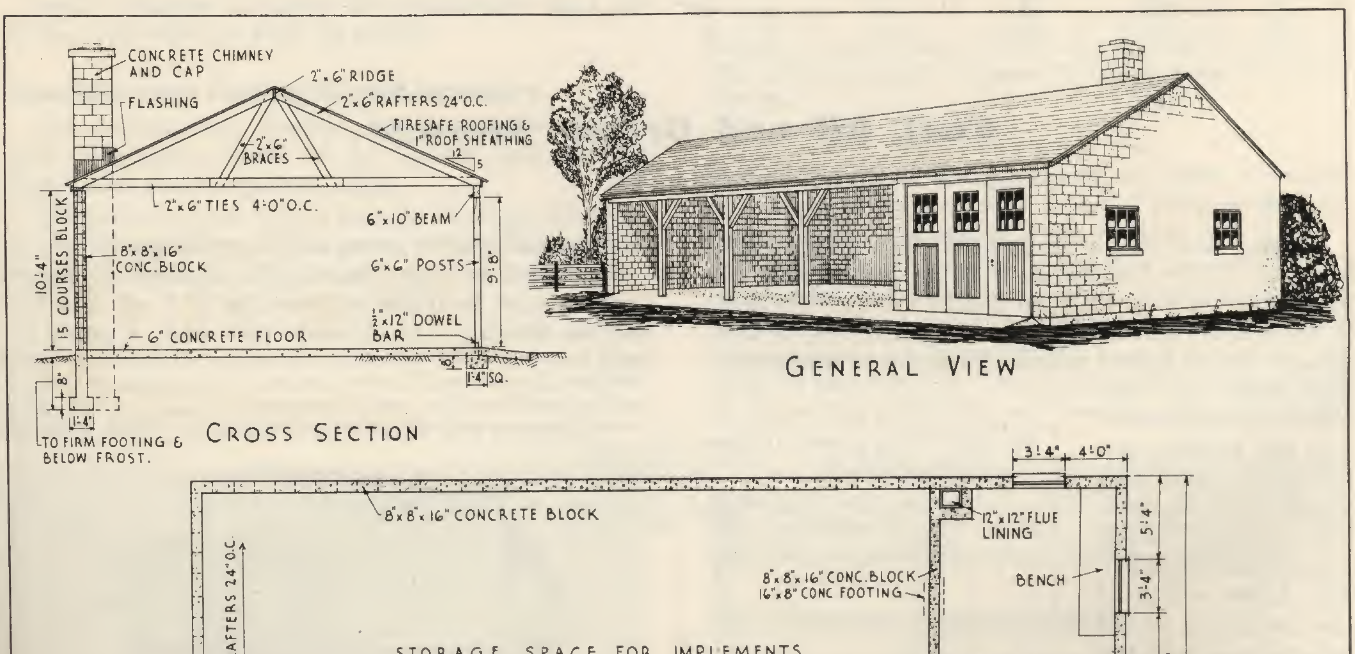
Locate the implement shed where machines can be easily put away and near the yard light if possible. If the front is left open it should face south or east.

Doors may be hung along the entire front if desired to keep chickens from roosting on machinery. The shop is partitioned off. A ceiling makes heating easier.

In estimating the size of building needed, it is best to make a list of machines to be sheltered and the space to be occupied by each. Then the floor area can be accurately planned to provide a definite place for each piece of equipment. Crowding should be avoided. Although dimensions of machines vary, the accompanying table compiled by the University of Minnesota should prove helpful in determining space requirements.

An attractive and serviceable implement shed with enclosed repair shop on one end.

An 18-ft. wide building will generally accommodate



Implement Shed and Farm Shop. Ask for Plan C-2174.

Dimensions of Various Farm Equipment Items

	Ft.		Ft.
Automobile	7x16	Manure spreader	7x12
Binder	8x15	Mower	5x 8
Corn binder	7x10	Potato digger	5x 8
Corn cultivator (1 row)	5x 6	Rake	6x12
Corn cultivator (2 row)	6x10	Side-delivery rake	8x12
Corn planter	6x 6	Silage cutter	7x 8
Disc harrow	5x 9	Sulky plow	5x 7
Gang plow	6x 8	Tedder	6x10
Grain drill	6x12	Tractor	7x14
Harrow	4x 6	Wagon	7x14
Hay loader	10x12		

one row of machines—26 ft. allows for two rows, with a long and a short machine placed opposite each other. Greater width than 26 ft. is uneconomical, making necessary larger trusses to support the roof, as well as objectionable center posts.

Walls are specified of concrete block although cast-in-place concrete may be used satisfactorily.

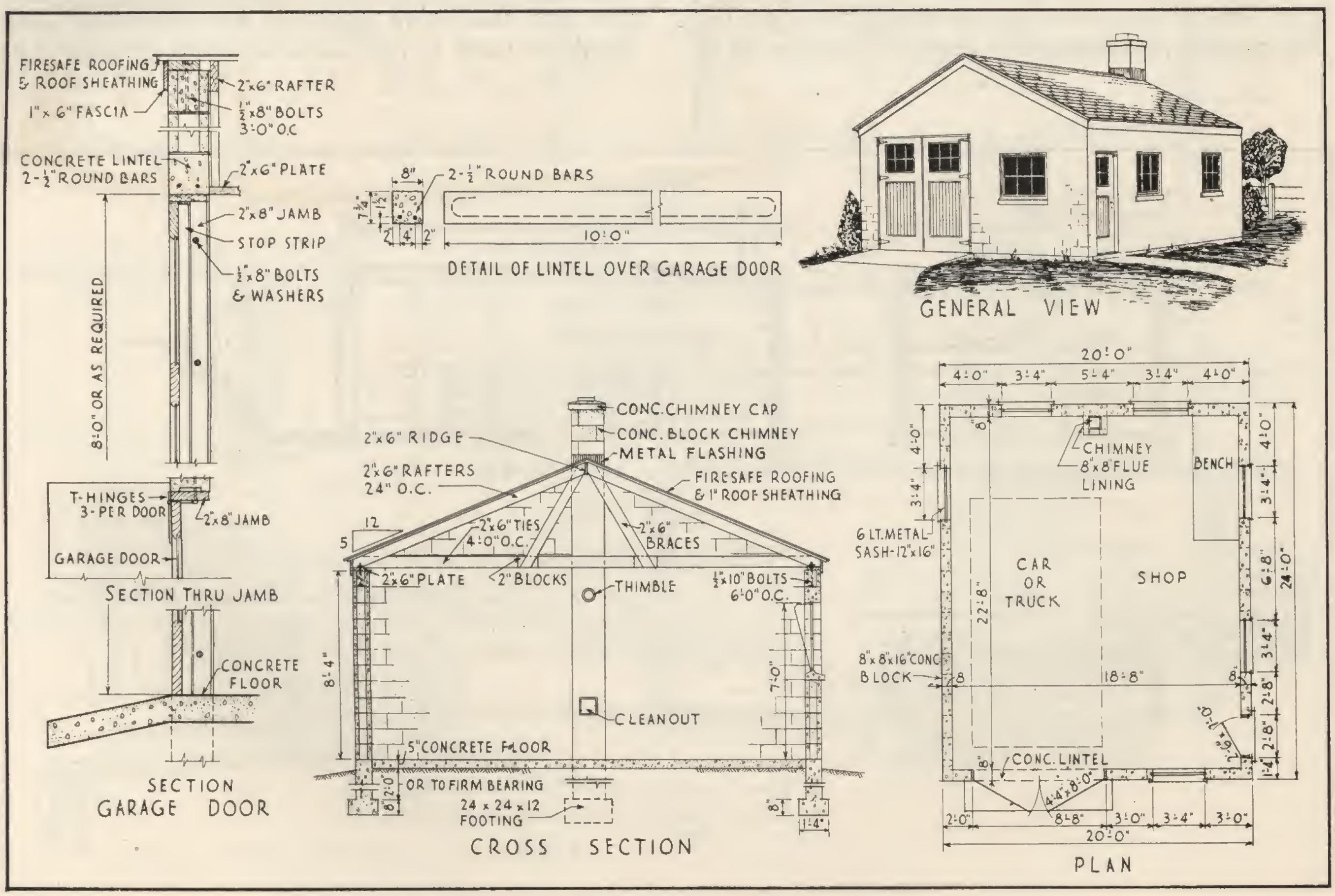
A tight roof is essential. Concrete floors are specified for both repair shop and storage room. They are durable, easily cleaned and permit heavy machinery to be moved about readily.

Garages

A concrete garage provides excellent facilities for housing the farm automobile, tractor, truck or shop. Firesafety, long life, low upkeep and attractiveness are features which make the concrete garage particularly adaptable for the farm.

For a single-car garage, an inside width of 12 ft. has been found satisfactory, while for a two-car garage, 20 to 22 ft. of width is necessary. Lengths of less than 20 ft. are seldom advisable and 22 ft. is better. If a truck is housed in the garage the length should be determined by the length of the truck.

Plan C-2210 of garage and farm shop is very desirable. This may be heated in winter and makes an excellent repair shop.



Garage and Farm Shop. Ask for Plan C-2210.

Storage Cellars

Small Storage Cellar

Underground storage cellars maintain cool temperatures and relatively high humidity, helping to keep produce in good condition over a considerable period of time.

Walls of the small storage Plan B-331 may be of either concrete masonry units or of reinforced concrete. Storages of larger size should generally be of reinforced concrete construction. The reinforced concrete roof of the storage is supported during construction on temporary wood forms.

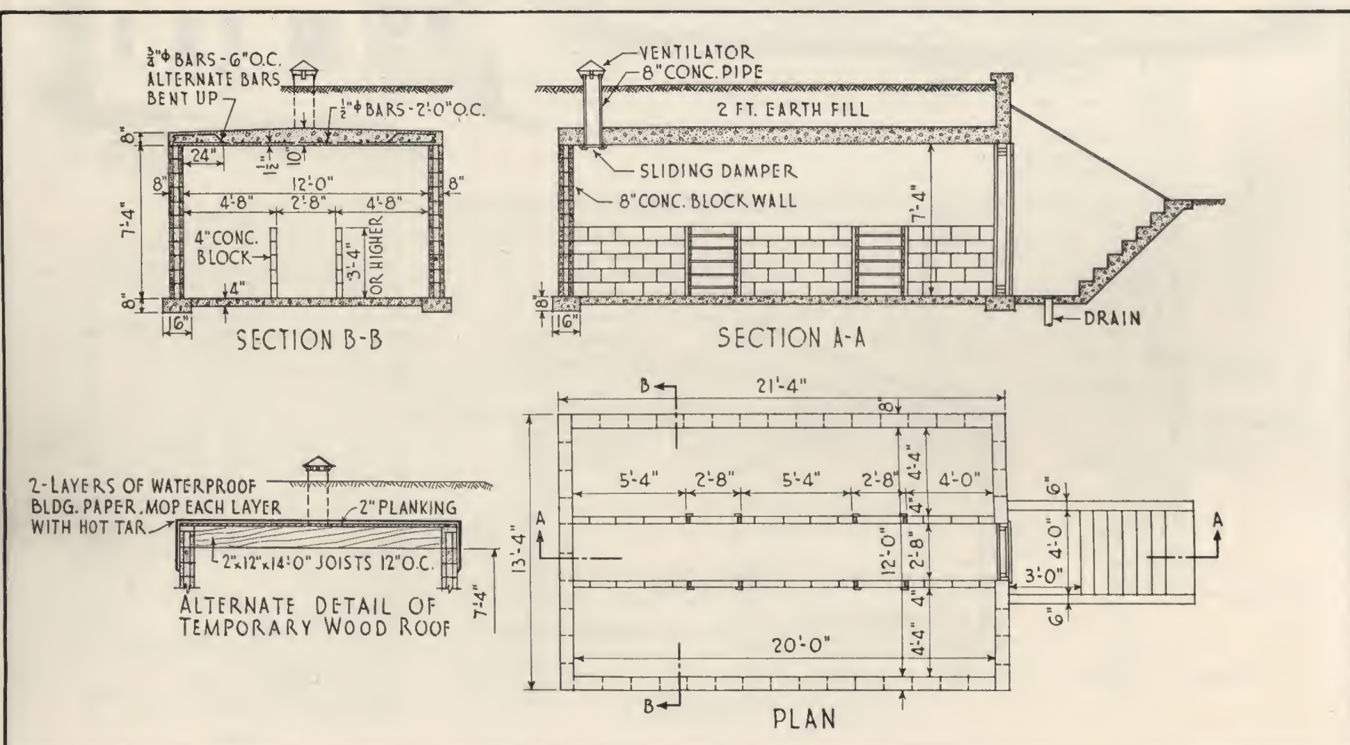
For greatest convenience, the storage cellar should be built into a side hill. This simplifies construction of the entrance and reduces labor in filling and emptying the storage. However, if the cellar must be located where the ground is nearly level, construction may be as shown in the plans.

Large Storage Cellar

The cellar Plan C-1834, being designed in 10-ft. sections, is adaptable to the requirements of practically any large fruit or vegetable producer. A cellar 68 ft. 8 in. long as shown will provide storage for 5,000 bu. The capacity is considerably greater if part or all of the driveway space is used for storage.

Home-grown fruit and vegetables can be kept in good condition for a considerable period of time when stored in an underground concrete storage cellar or cave.

Earth floors are considered best for the storage compartments as the moisture from the ground helps to maintain proper humidity in the cellar. A false floor and wall hold the stored crops away from the wall and floor and thus allow space for air movement. Care should be taken to provide for adequate drainage if it



Small Underground Storage Cellar. Ask for Plan B-331.

is not possible to locate the storage cellar on ground that drains naturally.

The central aisle driveway is floored with concrete. This provides a good firm passageway for moving fruit and vegetables in and out during all seasons.

Concrete block, building tile or cast-in-place construction are equally suitable. The columns, beams and roof slabs are of structural concrete reinforced with steel.

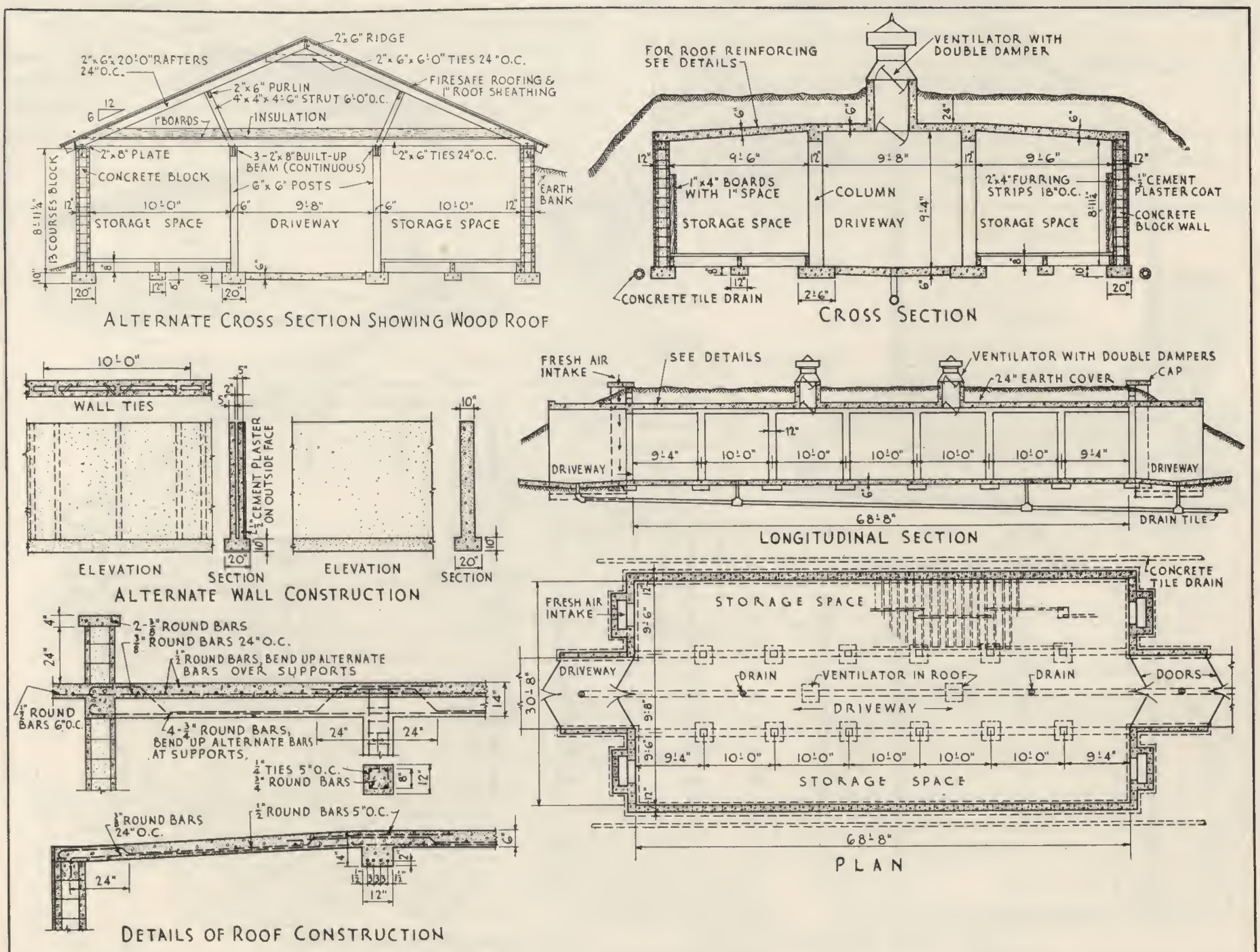
Above-Ground Storage Building

The above-ground type of storage building shown in Plan C-1834 for fruits and vegetables is less extensively used. It is customary to insulate the walls and ceiling of these houses to maintain uniform temperatures. They are commonly equipped with stoves which can be used during extremely cold spells.

An above-ground storage building may be built from the same plans as the cellar type. However, the foundation is built deep enough to extend below frost level and the entire structure, including doors and windows, tightly constructed to prevent possible leakage of air.

Nearly completed storage cellar with slightly arched concrete slab roof.

To provide additional insulation, a pitched roof, shown in the plan, is sometimes used. This construction allows for a layer of insulation material in the ceiling. As an additional precaution against heat transfer, fur out the walls with metal lath and plaster.



Concrete Storage Cellar with details for above or underground construction. Ask for Plan C-1834.

Tobacco Curing Barn or Sweet Potato Storage

Plan C-1533 shows construction details for a typical tobacco curing barn of concrete tile which can be converted to a building for sweet potato curing and storage.

Uniform heat distribution and control, savings in fuel and the firesafety of concrete have been important factors leading to the increased demand for this type of building.

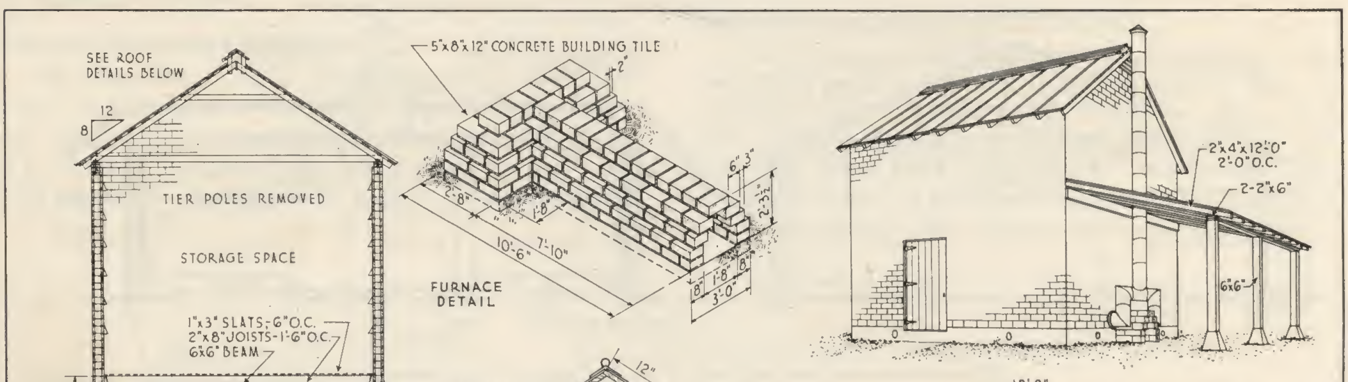
Experience shows that best results are obtained when care is taken to follow construction suggestions below.

How to Convert Tobacco Barn to Building for Sweet Potato Curing and Storage

The tobacco barn can easily be converted to a structure for the storing of sweet potatoes as follows:

1. When the walls are being built, place strap iron hangers 18 in. on center in the mortar joint which occurs about 3 ft. 3 in. above grade. These hangers are to receive false floor joists of 2x8 rough lumber. Hangers are needed only along the two side walls.
2. Make doors, windows, ventilators and other openings tight and screen inlet ventilators.
3. Remove tobacco tier poles and build false floor of 2x8 joists covered with 1x3 boards placed 6 in. on center as shown in drawings.
4. Apply building paper and solid sheathing to underside of rafters to make roof structure airtight.

The large door opening as shown in the plans is especially convenient in handling sweet potatoes. If the building is to be used only for tobacco, however, the rough masonry opening for the door may be reduced to 4x6 ft.



Tobacco Curing Barn Convertible to Sweet Potato Curing and Storage. Ask for Plan C-1533.

Greenhouses

Sash Greenhouse

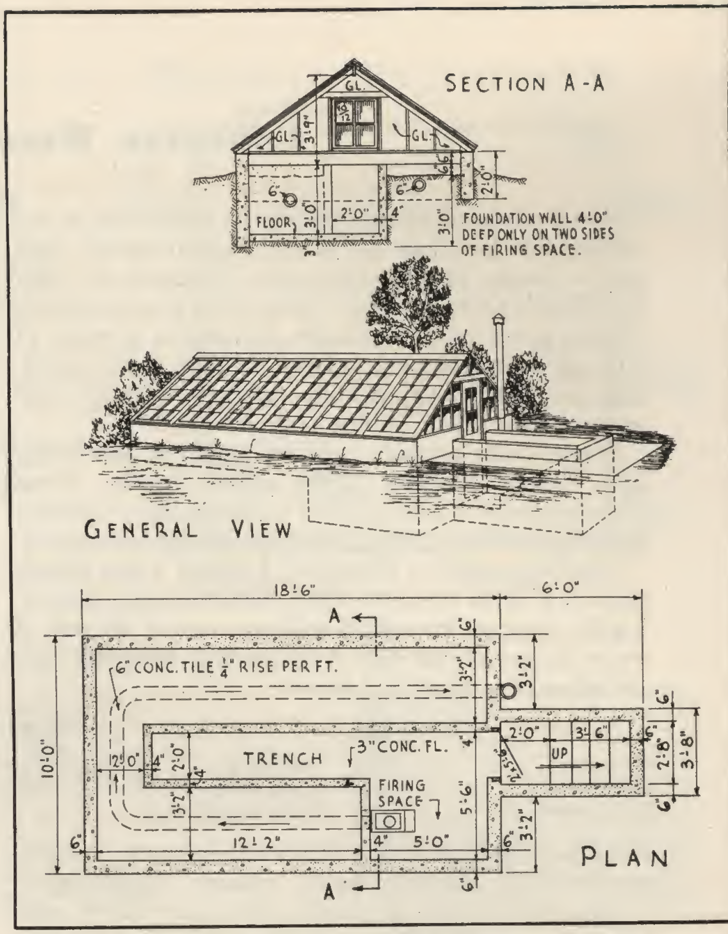
This small, low-cost greenhouse, Plan C-2239, is just the thing for starting seeds early and for beginners in the greenhouse business.

The walls are concrete or concrete block and the sash are regular hotbed sash. The greenhouse should be located on a well-drained site with a southern exposure and protected on the north. Heat may be supplied by a coal or wood stove, hot water heat, or electricity. Small water heating stoves are sometimes used for circulating water through coils under the benches. Modern electrical soil-heating cable is now used extensively in areas where power is available.

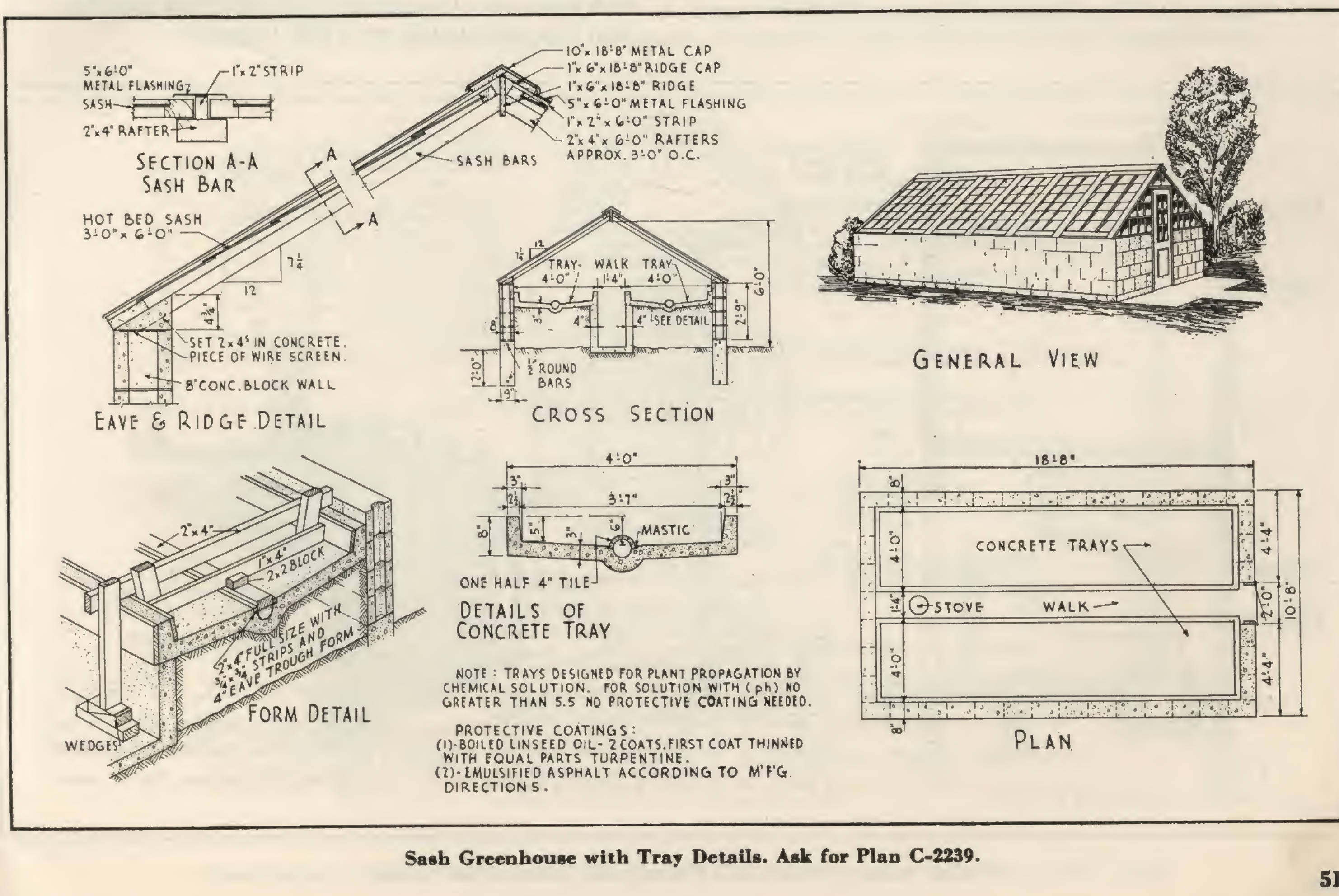
Flue-Heated Greenhouse

This type of house, Plan C-2240, is efficient and economical to construct. The pit permits a low structure that is easily protected from cold winds. The stove heats the soil through a flue in the soil. Electric soil-heating cable is also used extensively where power is available. Information may be obtained from your agricultural college concerning the adaptability of this type of installation.

Plant propagation by chemical solution is being widely used for the growing of flowers and to some extent in growing vegetables. The tray shown in Plan C-2239 is designed for this type of culture. Trays may also be used in Plan C-2240 if desired.



Flue-Heated Greenhouse. Ask for Plan C-2240.



Sash Greenhouse with Tray Details. Ask for Plan C-2239.

Concrete Water Supply Tanks

Water under pressure around the farmstead is one of the most practical and sensible improvements that can be made. The elevated tank illustrated by Plan C-1365 is one way to obtain water under pressure where electric power is not available. Roughly a pressure of 1 lb. per sq.in. will be developed for each 2½-ft. elevation the water level is above ground. Consult your water system dealer for size of pipe to use.

Water under pressure is of real value in preventing fires. Either elevated tanks which furnish water under pressure or underground storage tanks or cisterns from which water can be pumped are a good investment.

The most common mistake in building water supply tanks is to build them too small. With complete plumbing the average household will use around 40 gal. of water per person per day. Average daily livestock consumption of water is as follows:

	Gal.		Gal.
Each cow	25	Each hog	2
Each steer	12	Each sheep	1½
Each horse	12	Each 100 chickens	4

Most farmers find that a water supply tank of 3,000 to 10,000-gal. capacity meets ordinary requirements.

The construction of round tanks both above and below the ground is shown in Plans C-1365 and C-1364.

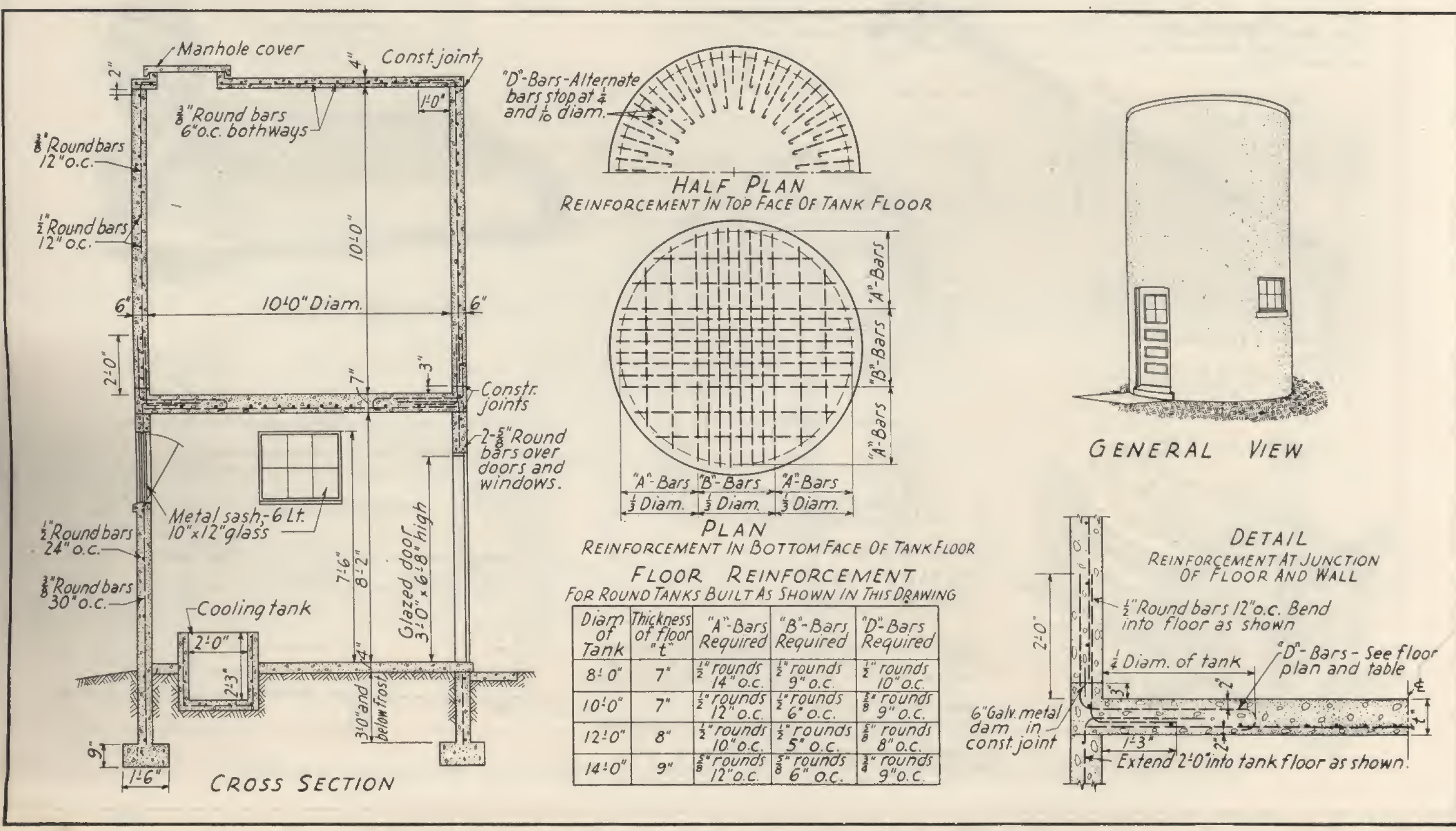
One of the principal benefits of running water in the farm home is the greater convenience provided on wash day.

Square tank construction below ground is illustrated in Plan C-1366.

Construction information for round and rectangular tanks and cisterns to hold 20,000 to 40,000 gal. is available on request. Ask for folder *Concrete Fire Cisterns**. For further information request booklet *Concrete Structures for Farm Water Supply and Sewage Disposal**.

In building the tank, concrete should be placed in a single, continuous operation if possible, walls of the tank being placed immediately following floor construction. For concrete mix see Table I, page 4.

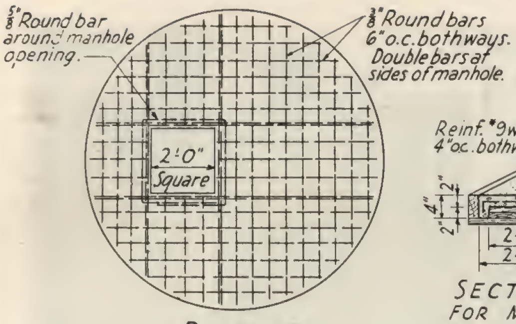
*Free in U. S. and Canada on request to Portland Cement Association.



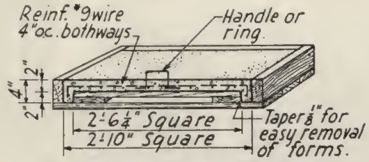
FLOOR REINFORCEMENT
FOR ROUND TANKS BUILT AS SHOWN IN THIS DRAWING

Diam of Tank	Thickness of floor "t"	"A"-Bars Required	"B"-Bars Required	"D"-Bars Required
8'-0"	7"	½" rounds 14" o.c.	½" rounds 9" o.c.	½" rounds 10" o.c.
10'-0"	7"	½" rounds 12" o.c.	½" rounds 6" o.c.	⅝" rounds 9" o.c.
12'-0"	8"	½" rounds 10" o.c.	½" rounds 5" o.c.	⅝" rounds 8" o.c.
14'-0"	9"	⅝" rounds 12" o.c.	⅝" rounds 6" o.c.	¾" rounds 9" o.c.

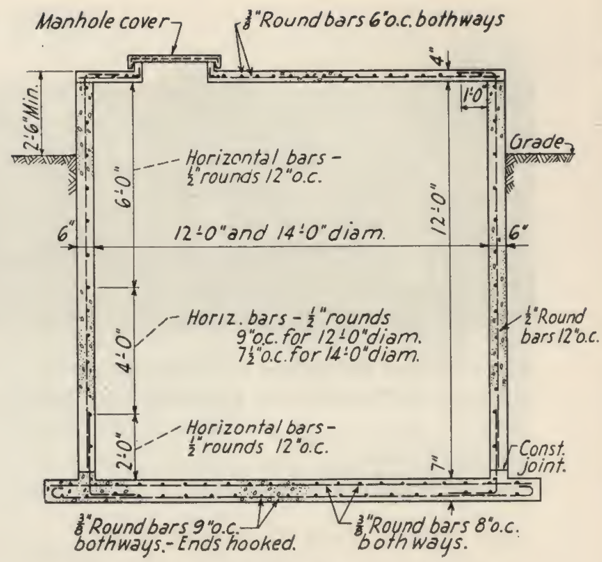
Cooling Room with Elevated Water Tank. Ask for Plan C-1365.



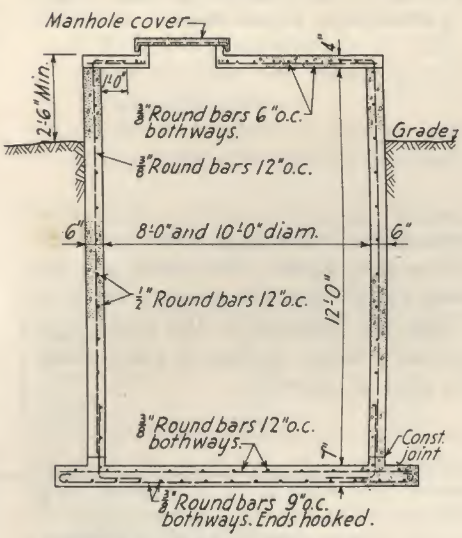
PLAN OF
ROOF SLAB REINFORCEMENT



SECTION THRU FORM
FOR MANHOLE COVER

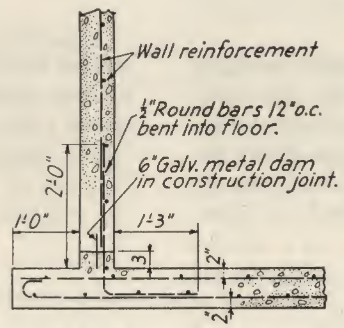


VERTICAL CROSS SECTION



VERTICAL CROSS SECTION

Note:
Increase wall thickness 1 in. where earth walls of excavation serve for outer forms.



TYPICAL DETAIL -
REINFORCEMENT AT JUNCTION OF
TANK FLOOR AND WALL

CAPACITIES OF ROUND TANKS
AND CISTERNS IN GALLONS *

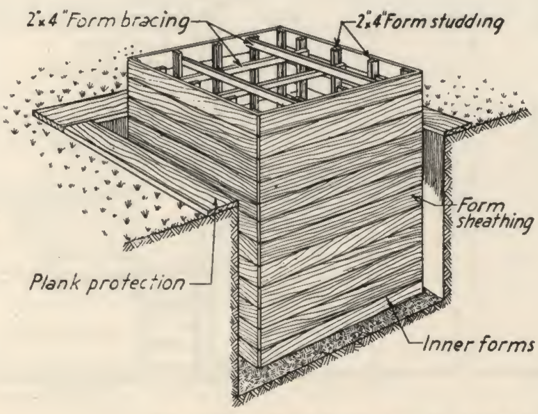
Depth in feet	Diameter in feet			
	8	10	12	14
4	1500	2350	3380	4610
6	2250	3520	5070	6920
8	3000	4700	6760	9220
10	3760	5870	8460	11520
12	4510	7040	10150	13830

* Diameters and depths are inside dimensions.

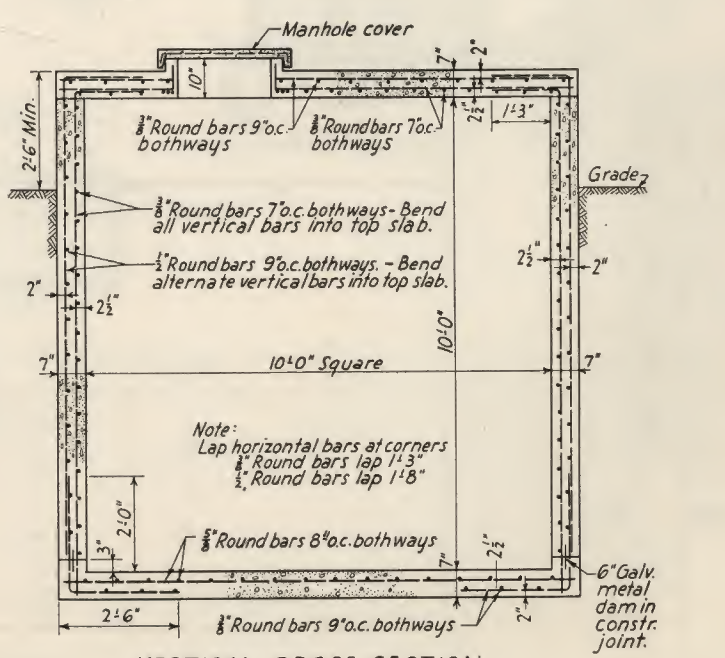
Construction of Round Tanks built in the ground. For details on other sizes ask for Plan C-1364.

CAPACITIES OF SQUARE TANKS
AND CISTERNS IN GALLONS

Depth in feet	Tank Sizes		
	8 ft. sq.	10 ft. sq.	12 ft. sq.
4	1,920	3,000	4,320
6	2,880	4,500	6,480
8	3,840	6,000	8,640
10		7,500	10,800
12			12,960



GENERAL VIEW OF INNER FORMS



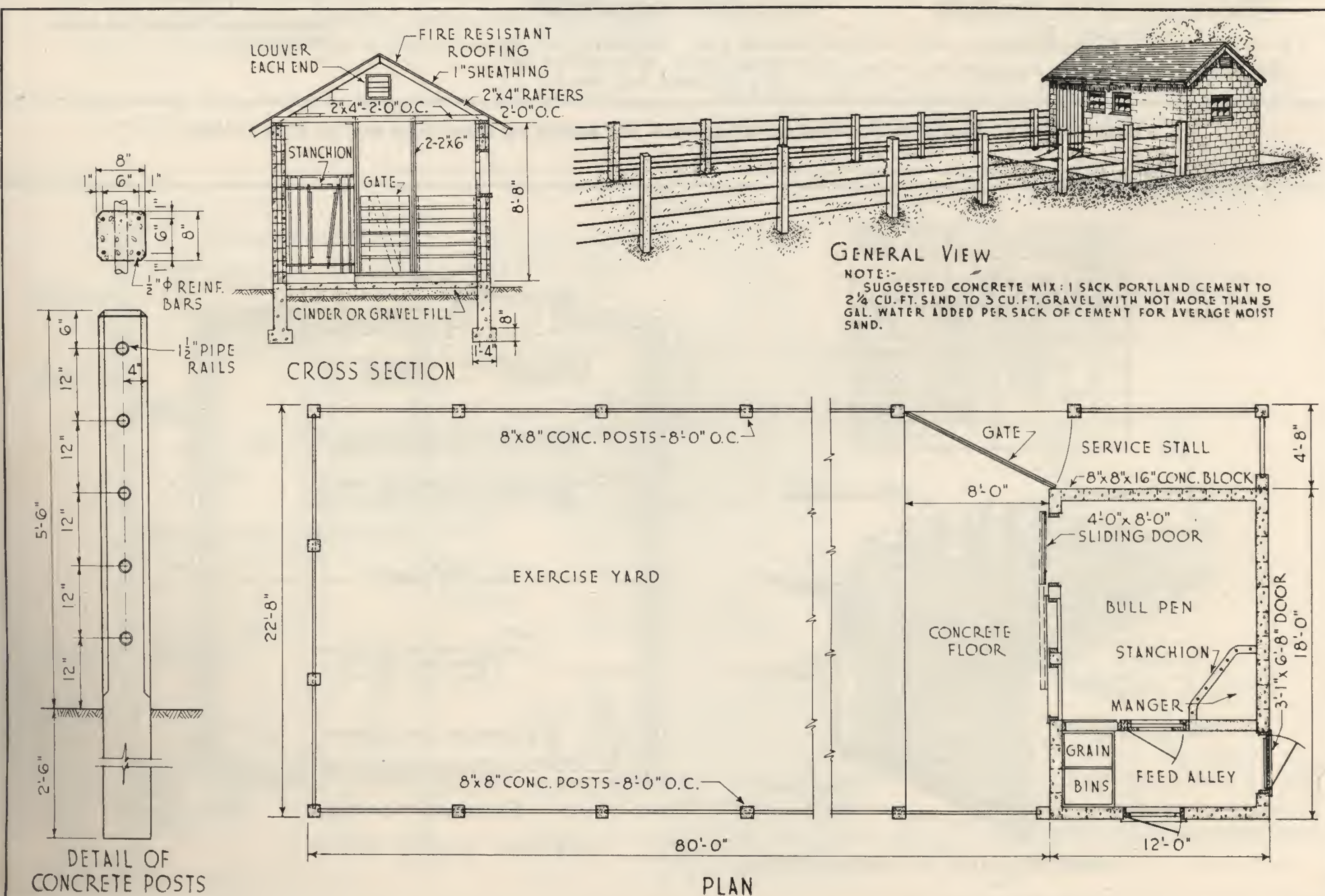
VERTICAL CROSS SECTION

Construction of Square Tanks built in the ground. For details on other sizes ask for Plan C-1366.

With this type of bull pen the herd sire has the advantages of ample exercise out-of-doors, yet he is safely confined behind strong concrete posts and pipe rails. Method of casting pipes into concrete posts is illustrated at the right.

Bull Pens

A substantial bull pen or paddock which permits sunlight, exercise and safe confinement for the herd bull is considered a necessity on the modern dairy farm. General practice is to enclose a space about 20x80 ft. Construction may be as shown in Plan C-2173 and in the photograph. Concrete posts are usually 8 or 10 in. square and 8 ft. long; ¾-in. triangular strips are used to line corners of the post forms. The posts are set about 8 ft. apart and 2½ ft. into the ground. Rails of 1½-in. galvanized pipe are fastened to the posts with U-bolts, or the pipes may better be cast in place along the centerline of the post as shown.



A Safe Bull Pen and Exercise Yard. Ask for Plan C-2173.

Concrete Manure Pits

Farm manure is valuable chiefly for its nitrogen, phosphorus and potassium content. Much of these valuable fertilizing elements is completely lost, however, if the manure is piled in an unpaved yard exposed to sun, wind and rain. Under such practice loss of nitrogen by fermentation and loss of phosphorus and potassium by leaching usually destroy more than half of the original fertilizing value of the manure.

Only two things are required to save most of the nitrogen and practically all of the phosphorus and potassium in the manure. These are:

1. Use bedding generously to take up the liquids which contain the larger proportion of the fertilizing elements.
2. Store the manure in damp, well-compacted piles in a watertight, weather-protected pit.

The fertilizing value of manure is much greater when properly handled.

These two practices followed faithfully will double the fertilizing value of farm manure.

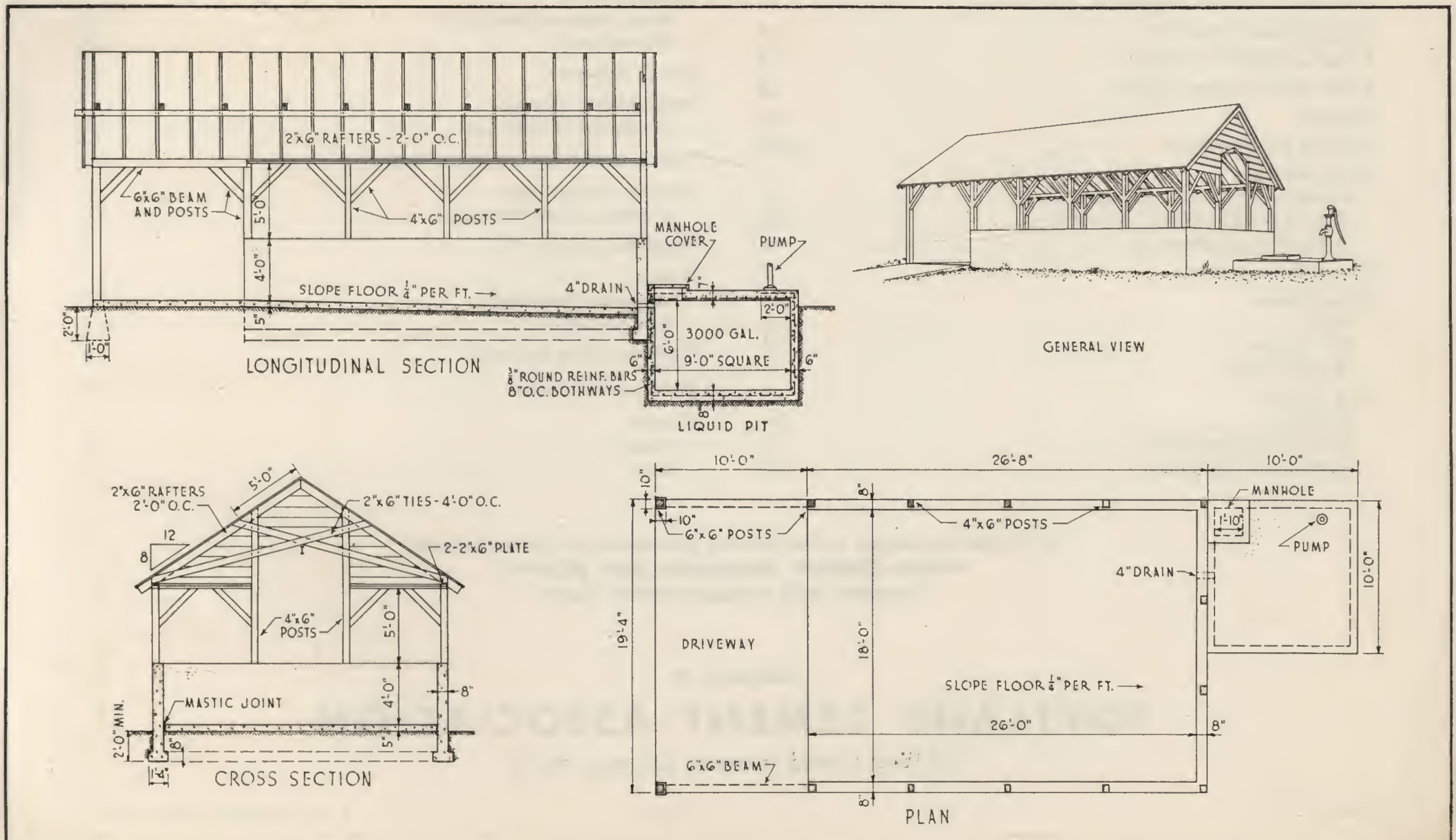
A concrete manure pit is a practical solution to most efficient handling of manure. The increased value of the manure will generally repay the cost of the pit during the first year or two of its use. The concrete pit is built 4 ft. high, with lengths and widths to fit the size of herd as follows:

10 cows—16 ft. wide, 16 ft. long.
20 cows—18 ft. wide, 26 ft. long.
40 cows—24 ft. wide, 40 ft. long.

Table XIX—Figure Out the Value of the Manure Produced by Your Livestock*

	Tons in 1 year	Value per ton	Value for 1 year
Horse	5.2	$6.09	$31.67
Dairy cow	8.5	4.56	38.76
Other cattle	4.0	5.47	21.88
Sheep	0.4	9.66	3.86
Hog	0.6	6.19	3.71

*These figures were taken from Pennsylvania Experiment Station Circular No. 67. Results from several other experiment stations accord with the above figures and substantiate the fact that mixed manure is worth at least $5 per ton.



Concrete Manure Pit with Liquid Tank. Ask for Plan C-623.

Index

For detailed information on the following subjects ask for booklet indicated.

MODERN CONCRETE REFRIGERATED FRUIT STORAGES

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